This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at http://books.google.com/

Digitized by Google

1837
ARTES VERITAS SCIENTIA
LIBRARY OF THE
UNIVERSITY OF MICHIGAN
E PLURIBUS UNUM
TUEBOR
SI QUAERIS PENINSULAM AMOENAM
CIRCUMSPICE

Digitized by Google

BF
685
.B98

Digitized by Google

Digitized by Google

Digitized by Google

PRINTED BY NEILL AND CO., OLD FISHMARKET.
EDINBURGH.

Digitized by Google

1—37 363

THE

PHILOSOPHY

OF

INSTINCT AND REASON.

BY

John

J. STEVENSON BUSHNAN,

M.D., F.L.S.

AUTHOR OF THE INTRODUCTION TO THE STUDY OF NATURE,

&c. &c.

EDINBURGH:

ADAM AND CHARLES BLACK,

BOOKSELLERS TO HIS MAJESTY FOR SCOTLAND.

MDCCCXXXVII.

Digitized by Google

readers,—small as that world may be,—that although differing with your Lordship on many highly important points, what is the high sense I entertain of your genius—enlightening every subject on which it glances; adorning every pursuit to which it applies its powers; and giving energy and direction to every measure which it influences.

In the following Treatise I differ from your Lordship in many opinions which you support in your late work on Natural Theology; but I am too well acquainted with your Lordship's character not to feel assured, that the expression of a conscientious conviction, however much opposed to your own, will always be received by you with candour and indulgence.

I have the honour to be,

Your Lordship's most obedient

And very humble Servant,

J. STEVENSON BUSHNAN.

ANSFORD HOUSE,
CASTLE CARY, SOMERSETSHIRE,
June 1837.

Digitized by Google

CONTENTS.

Digitized by Google

Digitized by Google

PREFACE.

In presenting the following work to the public, I can claim no greater merit than that of applying certain received principles of physiology to the subjects of which it treats; by which, as I cannot but feel convinced, they are disentangled from many of the grave objections applicable to the common views taken of them, and thereby rendered more worthy of a place in a rational philosophy.

The general reader, I am well aware, fears to encounter a treatise on Instinct and Reason, persuaded, as he is, of the little profit to be reaped from the established modes of discussing such subjects, and altogether unprepared to admit that they can be made obedient to any intelligible law or condition. This persuasion, however, on his part, has arisen entirely from those great principles of action having hitherto been treated of more in a

Digitized by Google

metaphysical than in a physiological point of view. And, indeed, to the abstruse and entangled style of metaphysical speculations, there is perhaps a stronger bias, at least in the majority of those who turn naturally to such inquiries, than to the plain and simple spirit in which physiological deductions must be conducted; so that I fear not a few may refuse to listen to the attempt I have made, in the following pages, to distinguish Instinct from Reason, rather by some essential differences in the condition of each, than by differences—often accidental—in their phenomena.

The physiological principles on which the views taken in this Treatise are founded—although it cannot be affirmed that they are all received, without exception, by the physiological world—are supported by the highest authority; and most of them are familiar to those who are acquainted with the writings of physiologists in the past, as well as the present age. But my chief obligations for the general tenor of the treatise are due to the instructions of my much lamented friend and preceptor, the late Dr Fletcher.

In Dr Fletcher, Edinburgh lost an ornament, brilliant even among the many shining lights that

Digitized by Google

have adorned her academic walks; her Schools of Medicine, a teacher whose erudition and acumen had begun to infuse new vigour into their constitutions; science, a labourer who gave rich promises of adding to her stores; and the favoured few who were bound to him by the ties of intimacy, a friend, who walked, almost alone, in the affectionhe excited.

J. S. B.

Ansford House,
Castle Cary, Somersetshire,
June 1837.

Digitized by Google

Digitized by Google

THE

PHILOSOPHY

OF

INSTINCT AND REASON.

CHAPTER I.

INTRODUCTION.

THE actions of the inferior animals, in as far as they conduce to some particular end, and appear, therefore, to imply motive and foresight, are in general referred to INSTINCT; while all those of man of a similar character are in turn traced to REASON. There is commonly displayed the utmost unwillingness to allow any glimmerings of *Reason* to brutes, since such an admission seems to exalt them beyond their proper sphere, by conceding to them a portion of what we have been accustomed to consider the chief attribute of man; and an equal repugnance to acknowledge that any of the actions of man are *Instinctive*, since he appears to be humbled by being represented as ever actuated by any principle in common with brutes. The epithet of Rational Being is very generally appropriated to man,

Digitized by Google

as the direct antithesis to that of Brute, which is applied to all other animals; and prejudiced people are always disposed to make this assumed line of demarcation as distinct and as wide as possible. Nor is this prejudice confined to the vulgar—nay, it is, in all probability, from philosophers that they have originally imbibed this, as well as most other fallacies. It has been from the earliest ages assumed in most schools of philosophy, that the lower animals are guided by definite instincts to the full attainment of all their wants, and all the ends for which Providence has designed them—that they do not require reason, and therefore do not possess it; whereas that man, being destitute of any such definite instincts to guide him, and requiring a full share of reason, at once to direct him to the accomplishment of his wishes, and to minister to the other and more important ends for which he was created, has been, on these accounts, endowed with this faculty. But this does not appear to be a legitimate way of disposing of the question. We should not begin by assuming that brutes are actuated by instinct alone, and man by reason; and then endeavour to reconcile all the actions of the former to the one, and all those of the latter to the other: but we should commence by expressly stating what are the conditions of an instinctive, and what those of a reasonable action, as discovered by a patient scrutiny of all the actions belonging to the relative functions of the animal kingdom, all of which, as we shall presently see, must belong to

Digitized by Google

one head or to the other; and afterwards rigorously refer to either head any action, whether of brutes or of man, which corresponds to the established definition of each.

As it appears to us, then, an instinctive action is one which, however directly it may minister to some important end, is performed without any consciousness, on the part of the agent, of that end; which is effected as perfectly the first time it is attempted as at any subsequent period, and which is quite unsusceptible of any adaptation to particular emergencies: while a reasonable action, on the contrary, is one which always implies a consciousness, on the part of the agent, of the end in view; which becomes only progressively perfect, and which is capable of being variously modified according to existing circumstances.

Now, can it be reasonably doubted, but that many of the actions, both of the lower tribes of animals and of man, are referable respectively to both these heads; or affirmed, that there exists any primary and essential distinction, on the one hand, between the principle which directs the young chick to pick up grain the instant it is hatched, and that which prompts the new-born infant to draw milk from the nipple of the mother the first time it is applied to it; or, on the other, between the principle which actuates an old bird in its manifest stratagems, either in the pursuit of advantage, or the shunning of danger, and that which guides an experienced man, in his various measures towards either the attainment

Digitized by Google

of good or the avoidance of evil? In the two former cases, there is no consciousness on the part of the animal, that the aliment taken is to repair the waste of the body; the action of taking it is performed as perfectly the first time it is attempted, as it could have been after a long course of experience and instruction; and it is invariably the same. In the two latter, on the contrary, the animal has a distinct consciousness of the object in view; he becomes, by experience, better and better acquainted with the most effectual means of attaining this object; and he can change or modify his measures, in proportion as such a change or modification seems requisite. We conclude, therefore, that, while some of the actions of the inferior tribes of animals are instinctive, others spring from reason; and again, that, while some of the actions of man are the result of reason, others spring from instinct,—the only difference appearing to consist in this, that, in brutes, the great majority of the actions are instinctive, while, in man, the great majority of the actions are rational; and that, in him, the faculty of reason very far surpasses, not in kind, but in degree, the same faculty in brutes.

Accordingly, while there is no tribe of man so savage as not to have acquired, by experience, some rude notion of tilling the ground, and learned at once the uses of fire and the means of kindling it, and of applying it to their necessities, there is no description of brutes so far advanced as, however necessary to their existence roots, fruits and grain

Digitized by Google

may be, or whatever comforts they may have derived from heat, ever to have attained to the means of artificially rearing the one, or producing, or even keeping alive, the other; and while, even in the wildest and most uncultivated tribes of the human race, some traces of a barbarous religion are constantly to be met with, no rudiment of such a sentiment has ever betrayed itself in the most highly gifted of the brute creation.

Still, these are differences in degree only, and not in kind; and the faculties and sentiments with which many brutes are endowed, appear to be quite competent, were they enlarged and expanded in a high degree, to lead, without any alteration in kind, to all the results which, as displayed by man alone, we commonly attribute to a distinct source; and those who adopt the opposite opinion, seem to differ from us only in as far as they fix their standard of reason somewhat higher than we do. They admit that most of the inferior animals learn many things by experience and education; but affirm that they are guided, in these cases, by memory alone, without observing that memory can only recall past events, and must be quite inadequate, without reason, to prompt an animal, either to repeat an action from which it has previously derived advantage, or to refrain from one from which it has already suffered injury. Again, there are few of the lower animals which do not manifest, besides hope and fear,—which must have actuated them in the instances already adduced,—gratitude to those who

Digitized by Google

have been kind to them, and dislike to those by whom they have been ill used, as well as frequently a decided love of justice, and a hatred of oppression in general. Such impulses as these meet the definition which *we* are disposed to adopt of reason, without any addition of those strictly intellectual or highly moral qualities, which, by some persons, are made essential to this principle. In these, brutes are unquestionably deficient: they want the more exalted degree, as well as the more continued exercise, of the faculty of reason, which distinguishes man, in his most abject state, from the higher tribes of other creatures, and which, as it renders him alone a responsible agent, opens upon him alone the prospect of eternal retribution, as his actions shall have been conformable, or otherwise, to those precepts of religion and morality, which he alone is capable of understanding.

And this analogy between the lower tribes of animals and man, in as far as regards the admission, in both, of a double principle of action, will be still more obvious, if we contemplate for a moment the phenomena of Idiotism,—a state which, when extreme, reduces proud imperial man to the level of the lowest brute; and it has accordingly been said by Dr. Paris, upon the common presumption that brutes are guided by instinct alone, that an idiot "cannot reason at all,—he acts from animal appetency, and has no will." But we must remember, that the difference between the veriest idiot and a man, not only of sound mind, but of the most exalted under-

Digitized by Google

standing, is in degree only, and not in kind; and, assuming, for an instant, that the only incentive to action in the brute is instinct, and in the sane man reason, at what point of his degeneracy shall we say that an idiot ceases altogether to be actuated by the latter, and begins to be actuated by the former alone? There is certainly no such point. The instinctive operations of an idiot are not more numerous than those of other men, but his rational operations, in proportion to the degree of his infirmity, are fewer and less dignified, and in so far he approximates to the lower animals. His principles of action are still two; but the nobler falls into obscurity, while the baser remains unchanged. "Do we wish," says Virey, "the directing and preserving power"—that is, instinct—"to become apparent? Weaken the understanding, which restrains or opposes it, and it will immediately revive to take the reins of the organic machine, and thus prevent it from destroying itself."

It belongs to the introductory part of this work to remark, that some care and attention are occasionally requisite, if we would avoid confounding purely instinctive acts with acts of reason, notwithstanding the apparent distinctness and easy applicability of the two definitions which we have laid down. The acts of instinct, which are apt to put on the disguise of reason, are principally those developed in extraordinary circumstances, so that it seems as if the animal accommodated itself, by a process of

Digitized by Google

reasoning, to a new state of things. But instincts are not innate, any more than ideas. Every instinct is called forth by impressions made on sensation, as will hereafter appear more clearly; so that, in the same species, or even in the same individual, it often happens that, owing to the non-application of certain impressions in the earlier part of its existence, certain corresponding acts appear only in the course of life, or not till the impressions which were destined to excite them come to take effect. This is particularly the case with many habits acquired by animals, when transported by man to new climates.

We have hitherto presumed that instinct and reason are essentially different in their nature, and made it a question only, whether one were proper to brutes, and the other to man; or whether each were common, under certain conditions, to both. But it would be improper to leave this part of our subject without remarking, that, by some philosophers, it has been believed that there is no real distinction between them,—that instinct is but an inferior degree of reason, or—what amounts to the same thing—reason but a superior degree of instinct. Thus, by Darwin, all the reputedly instinctive actions are regarded as really intellectual operations, lower or higher, according to the less or more elevated rank of the animal; while, by Hume, all the actions commonly called rational, are looked upon as in fact, a train of instinctive movements, the number of which is, in every animal, greater or

Digitized by Google

less, in proportion to its place in the scale of creation. We have above stated, as one characteristic of an instinctive action, that it is from the first perfect, and does not, like a rational action, become only progressively so in proportion to experience; but Dr Darwin is of opinion that no action is at first perfect;—that the young chick, for example, has undergone a kind of apprenticeship to the business of picking up grain,—which it does perfectly as soon as it emerges from the shell,—by having been accustomed, during the whole period of incubation, to swallow a portion of the egg for food; and he thinks it "not unreasonable to conclude, that some of the actions, both of large animals and of insects, may have been acquired in a state preceding the present one, and have been derived from the parents to their offspring, by imitation, or other kinds of tradition." Again, we have above represented a consciousness on the part of the agent, of the end in view, as one distinguishing mark of a rational action, as opposed to an instinctive one; but by Mr Hume it is asserted, "that the experimental reasoning itself, on which the whole conduct of life depends, is nothing but a species of instinct, or mechanical power, that acts in us unknown to ourselves, and, in its chief operations, is not directed by any such relations or comparisons of ideas as are the proper objects of our intellectual faculties." By Darwin, every thing is thus referred to reason; by Hume, every thing to instinct; and in either case, of course, the old esta-

Digitized by Google

blished distinction between brutes and man, with respect to their supposed different principles of action, must be nugatory. This we have no hesitation in believing to be the case; not, however, because there is but one principle of action, which, of course, must be common to both, but because both afford evidences of two principles of action, which—as we hope to make it appear in the sequel—are fundamentally distinct from each other.

As we have remarked in our preface, we apprehend that a great deal of the difficulty and obscurity which hang over the subjects of instinct and reason would have been obviated, had the investigation been taken up rather in a physiological, than in a metaphysical spirit; and had the attempt been made to distinguish the one from the other, rather by some essential differences in the conditions of each, than by any differences—often, perhaps, accidental—in their phenomena. In this view of the matter, instinct and reason, as the actions of living beings, should be regarded only as functions, as much as sight or hearing are functions; and as every function requires two conditions, namely, a faculty, on the part of the body, of being acted upon, and some power to call this faculty into action, so this must be the case with instinct and reason. But if the conditions in both cases were the same, the functions could not be, as we have above assumed they are, essentially different; we must be prepared to prove, therefore, or at least to

Digitized by Google

render it probable, that the conditions of instinct and reason are primarily and fundamentally different.

Before, however, entering on the proper subject of our treatise, it seems necessary to lay before the unprofessional reader a short explanation of the nature of the functions of organized bodies; and then to pass on to the anatomy of the nervous system throughout the several orders of animals. The latter, which, however, we shall render as brief as possible, must necessarily be somewhat tedious; yet, as the after part of the treatise is altogether founded upon the functions of that system, as it is more and more developed, as we ascend from the lowest link of the chain of organized beings, through the avertebrate animals—the zoophytes, worms, and insects—to the vertebral—the fishes, reptiles, birds, and mammals—till we arrive at immortal Man, the most exalted example of animated nature, and whose superiority appears, in a great measure, to depend on the more perfect organization of this system, it seems impossible to treat the subject in any other way, without departing from the first rule of physiological investigation. To render, however, the descriptions more intelligible to the non-medical reader, we shall refer to a few lithographic plates which we have introduced for this purpose.

Digitized by Google

CHAPTER II.

THE FUNCTIONS OF ORGANIZED BODIES.

As there is no kind of action, in the economy of organized bodies, which has not been referred, by one philosopher or another, to instinct, it will be useful, before proceeding further in this inquiry, to pass these several kinds of action under review, and to attempt to arrange them under appropriate orders. Matter is divided into two great classes, termed generally the Inorganic and Organic; the former includes all mineral substances, the latter all vegetables and animals. Both are formed probably by the combination of more or fewer of the same primary or elementary principles; but the characters of the resulting compounds, and the properties which they display, are essentially different.

Of the differences between these two great kingdoms of nature, it is not necessary here to treat; suffice it to say, that a distinguishing mark of an organic substance, in as far as its structure is concerned, is, as the name implies, the possession of certain *organs*, each of which is more or less essential to the welfare of the whole; and an equally distinguishing mark of the same substance, as far as

Digitized by Google

regards its motions, is the performance by these organs, each of its own proper *function*, in the sum of which the life of the being appears to consist. A *function* therefore may be defined to be the proper action of a living organ, or set of living organs, conducive to some definite end in the animal economy. It is therefore quite distinct from a *property*, such as that of excitability, or a *power*, such as that which calls excitability into action, since it signifies such properties and powers in mutual co-operation. Every action of every individual organ of the animal body is its function, and the due performance of this is the only end of its existence; but the functions, collectively considered, are commonly classified according to the particular end to which more or fewer of these actions are subservient, since they would otherwise be altogether innumerable, and the consideration of them would involve a series of useless repetitions, and present an inextricable chaos without beginning or end. In this view, therefore, we include, under the head of the function of Digestion, all the actions of the several parts of the intestinal canal and its appendages, which are instrumental to the assimilation of the food; under that of the function of Circulation, all the actions of the heart, bloodvessels, and other parts, which are subservient to the propulsion of the blood; and under that of the function of Respiration, all the actions of the chest and its contents, which minister to the conversion of the venous into artetial blood and many other important ends. It is

Digitized by Google

obvious, therefore, that the number of functions admitted into any treatise on physiology, is almost entirely arbitrary,—each of those just mentioned, including perhaps twenty distinct functions of twenty different parts; any one of which might have been selected, if we so pleased, and treated of as a separate function. But if the enumeration of the several functions be so indefinite, their arrangement is hardly less so; and accordingly, not only very different heads of functions, but very different arrangements of these heads, are to be met with in different authors. By the Father of Medicine, the sum of the functions of the living body was aptly compared to a circle, in describing which we may begin at any point, and set off in any direction we choose; and there is certainly no point at which we can begin, but it requires a great deal of previous knowledge to render it at all intelligible, and none which can be in any degree exhausted, without involving, more or less, the consideration of every other function of the body. One leading ground of distinction, however, between the functions is, that while some of them require only *excitability*, or *irritability in general*, more properly speaking, to be called into action, and are carried on without the consciousness of the individual, and not only independently of the will, but even against the will, others require some new properties superadded to general excitability, such as *sensibility* and *susceptibility of thought*, and are not only attended with consciousness, but subject, in a great measure, to the controul

Digitized by Google

of the will. The former of these have been called collectively the *organic functions*, since they are common, under some modification or other, to all forms of organized beings, vegetable as well as animal, and include all those to which we have already alluded; the latter have been called *animal functions*, since they have been presumed to be characteristic of animals, and include sensation, thought, and voluntary motion.

Plants and animals possess, in common, the nutritive and reproductive functions, and these two orders taken together, constitute the functions of organic life, including all those concerned in the development, repair, and maintenance of the individual, and the continuance of the species. These actions vary almost without limit in the wide range of the two organized kingdoms of nature, yet continue to possess throughout certain distinctive features. The end of all the actions of this great order, is directly or indirectly subservient to the conversion into their substance, or the assimilation, as it is technically called, of certain substances; in plants, principally of water and carbonic acid; and in animals, of saccharine, oily, and albuminous matters, the products of vegetable or of animal life; or, finally, of forming certain productions or secretions essential to the renewal of the species. The circulation of a nutritive fluid, the successive additions to this fluid by nutritive absorbing vessels, the purification of this fluid by exposure to the atmospheric air, the elimination of superfluous or noxious particles from

Digitized by Google

it, and finally, the consolidation of its constituent parts into solids, or their conversion into lubricating or otherwise useful humours, constitute the leading acts of organic life throughout both organized kingdoms of nature.

To ascribe such acts as these to instinct, appears at first sight little short of the height of extravagance in speculation; yet we shall find hereafter, that they have been referred to such a principle, and that by philosophers who are reputed sound thinkers on most occasions; nor, indeed, is it so easy as one might naturally suppose, to draw the nice line of distinction between the principle on which they depend, and that which is properly regarded as instinct.

All the other acts of organized bodies belong to the functions by which relations become established between the individual and the world without, and these, therefore, are termed the Functions of Relation, or the relative functions; and because they hardly exist, or do not at all exist, in plants, while they constitute a prominent feature in the animal kingdom, they are also called the Animal Functions, or the functions of animal life.

The relations which can become established between an animal and the external world, are twofold—relations of knowledge and relations of power. Relations of knowledge are the result of sensibility and the internal acts connected with it, as, in the higher animals, of the five external senses on the operation of the intellect and of the moral feelings:

Digitized by Google

relations of power, founded on the muscular frame, are the faculty of locomotion, the exertion of strength, the production of the voice, &c. and, under this order, all the acts usually referred to instinct and reason are principally placed. It is often made a question, whether plants do not possess some rudiments of functions of this kind, and whether there are not some animals altogether destitute of them. It will appear hereafter, that some of the phenomena of plants, in the existing state of our knowledge, so closely agree with the condition of this order of functions, and with that of instinct in animals, that no satisfactory circumstance of difference can be pointed out between them. And as to the second question, it may be remarked, that although the evidence of the existence of this order of functions in the very lowest animals be obscure, yet both analogy and all the recent additions to our knowledge as respects both the habits and structure of such animals, are very favourable to the belief of this order of functions, however limited in degree, being co-existent with the animal kingdom.

Such, then, is the ordinary general arrangement of the functions of animals, founded on presumed differences in their essential conditions; the former class requiring for their display only a general property common to all living matter, the latter some specific properties in addition; but there is another, and perhaps a better foundation for such an arrangement, in certain general ends, to which more or fewer of the several functions—independently of

Digitized by Google

the individual end to which each is subservient—conjointly conduce. These general ends are three: the ultimate object of every function being either to preserve the individual in a state of life and health, to perpetuate its species, or to maintain its relation with the external world; and in this view of the matter, the functions have been arranged into the *nutritive*, the *reproductive*, and the *relative*. Of these, the first head includes digestion, circulation, secretion, absorption, and respiration, all of which extend no farther than the individual, and have no ulterior end; the second includes generation alone, and is exercised for the sake, not of the individual, but of the race; and the third includes sensation, thought, and voluntary motion, and furnishes us with the only means which we have of maintaining an intercourse with each other, with nature, and with nature's God. It is sensation and thought which constitute the proper subjects of this work. It will be observed that this arrangement does not differ very materially from the preceding; in fact, it leads to the same order of succession in classifying the functions, but, as founded on less questionable principles, and leading to a more precise nomenclature, it appears to be infinitely preferable to it. Further, it is the best adapted continually to inculcate upon the mind the main purposes of our existence as living and rational creatures; and to lead us to observe, while investigating the phenomena of each function, the admi-

Digitized by Google

rable adaptation of the means to the object, not only individual, but general, for which this function was appointed, and to which, in common with others, it conduces, as subservient, directly or indirectly, to the great end of our being.*

* See our "Introduction to the Study of Nature." London: 1834.

Digitized by Google

CHAPTER III.

SKETCH OF THE NERVOUS SYSTEM IN MAN AND THE VERTEBRATE ORDERS OF ANIMALS.

If the exercise of function in living creatures, imply the operation of a certain power or property on an organ or instrument, the step which should follow such a careful observation of the phenomena as the case will permit, is an examination of the organ itself under every possible bearing. Throughout every department of physiology, the phenomena fall under notice before any knowledge is obtained concerning the organ itself, or of its connection with the power which calls it into activity. Men observed that the use of food renewed their exhausted strength and stimulated them to fresh exertions, long before they were enabled to inform themselves what share in this effect was to be assigned to the stomach, what to the liver, what to the bowels, what to the lacteal tubes, what to the heart and bloodvessels, what to the lungs. Nor should the case be very different as respects the operations of instinct and reason, the phenomena of which are

Digitized by Google

known but to a limited extent. It is proper, then, to attempt to add to our imperfect knowledge of these subjects by the investigation of the organs on which their operation cannot but be acknowledged to depend; and it were superfluous to prove that the nervous system must be the organ through which all such acts as rank under these two heads are produced. This system, for example, in man, is not so much one organ as a collection of several organs, each distinguished by special endowments or properties, severally subservient to different functions, or at least to different parts of one or two great functions; while in other animals of the higher orders, its parts vary in number and development nearly in accordance with the degree in which each approaches to man in character; and further, the lowest tribes, which shew little of the powers characteristic of man and the higher orders, are destitute of many parts of the same system. Here, then, is offered a basis for a physiological inquiry into the distinction between the two great principles of action, the consideration of which forms the subject of our work; and the following brief outline, which in this place is all that can be offered, will at least indicate the high situation which the comparative anatomy of the nervous system must hold in such an investigation. In it are comprised, first, a short account of the nervous system in man, and the variations from it presented in other mammals, as well as in birds, reptiles, and fishes; and, secondly, a succinct statement of the progress of

Digitized by Google

its development throughout the avertebrate orders of animals, from the infusoria up to the highest o the mollusca.

It would be premature to hazard a definition of a nervous system, while the extent of its properties and influence in the animal economy is undetermined; certain descriptive characters, however, belong to it, by which it is usually possible to ascertain its presence, even in animals of the lowest rank in the scale. These are drawn from its anatomical structure and disposition, its chemical qualities, and partly even from its properties as displayed in the acts or habits of an animal.

The elements of a nervous system are, in every known instance, a nervous centre and nerves. A nervous centre consists of certain soft, pulpy, inelastic parts placed internally in the body of an animal, varying extremely in development, as from a few minute rounded knots connected by similar filamentous lines, up to the elaborate complexness of the human encephalon and spinal chord. The nerves are threads composed of the same, or a similar kind of matter, which spread from the centre to the periphery of the body, throughout its extent, connecting all, or nearly all, its parts with the nervous centre.

Digitized by Google

SECTION I.

THE NERVOUS SYSTEM IN MAN.

In the vertebrata of Cuvier's system—which we here follow without any material modification—comprising the four great orders of mammals, birds, reptiles, and fishes, the nervous system is made up of an encephalon and spinal chord, together with the ganglionic and other nerves. The encephalon comprises all the nervous parts lodged within the skull, as the brain, the cerebellum, the optic tubercles, the peduncles of the brain, the peduncles of the cerebellum, the annular protuberance, and the medulla oblongata. The word *brain*, then, it is to be remembered, in strict anatomical language, such as ought to be employed even in a popular scientific treatise, excludes several parts contained within the head, and corresponds merely to the word *cerebrum*, or brain proper. The necessity of the closest attention to precision in language must have struck every one conversant with works of anatomy; where, notwithstanding the apparent facility of avoiding the use of contradictory terms, owing to the descriptive character of the science, opposite views of the acceptation of a word too often create an inextricable confusion. Thus in the arrangement of the parts of the nervous system in vertebrate animals, the subject under consideration, the student dis-

Digitized by Google

covers a variety of significations among our most approved authors, attached to the term cerebro-spinal axis. Thus the nervous system is often said, and very properly, to be composed of the cerebro-spinal system, together with the great sympathetic and other nerves. Here the cerebro-spinal system refers to the whole encephalon or parts within the skull along with the spinal chord; or the cerebro-spinal system is properly made to include the whole nervous centre of such animals. All this is very plain and obvious, but how is the student perplexed when, on opening another work perhaps of equal authority, he sees that the term Axis is substituted for System, while in others the nervous system in the same animals is made to consist of a cerebro-spinal axis, the cerebrum, the cerebellum, the sympathetic, and other nerves.

The term cerebro-spinal axis, is then sometimes employed synonymously with cerebro-spinal system; sometimes to signify the spinal chord, the medulla oblongata, the annular protuberance, and the optic tubercles, or the whole of the nervous centre in vertebrated animals, with the exception of the brain itself and the cerebellum. In this signification it is not less expressive than convenient, and it is therefore made use of in the present sketch; the few remarks above offered, sufficing to avert any ambiguity.

In man, then, and in the other vertebrate animals, the nervous system is composed of a cerebro-spinal axis, extending upwards from the lower part

Digitized by Google

of the vertebral column into the skull, to terminate with the optic tubercles, its highest point; of the brain and cerebellum superimposed on this vertical column or axis; together with the great sympathetic or ganglionic nerve; and the other nerves dispersed over the body. Of each of these parts a brief account must be given.

Our first lithographic plate, after Paxton, and Fig. 1 represents one side of the brain and spinal chord, shewn by making a section of the cranium and spinal column. In it, *a* refers to the cerebrum; *b*, the cerebellum; *c*, the medulla oblongata; and *d*, the spinal chord, extending from the first cervical vertebra, and terminating at *e* in the cauda equina.

The canal in which the spinal chord, or inferior part of the cerebro-spinal axis, is lodged, is formed behind the vertebral bones by an osseous arch attached to each, and extended more or less obliquely backwards, constituting the prominences so easily discovered with the finger along the middle of the back. The chord itself is nearly cylindrical, being, however, somewhat less in diameter from before backwards than from side to side; it does not any where much exceed half an inch across. It occupies the two upper thirds of the vertebral column, its lowest point being at the upper part of the loins, where the pia mater, or the membranous covering of the chord, together with the origins of the lumbar and sacral nerves, descend into the lower part of the canal, under the name of cauda equina,

Digitized by Google

from its filamentous appearance, resembling a horse's tail. The chord itself, which does not even nearly fill the canal, ascends to pass into the skull by the great occipital hole, where it assumes the name of medulla oblongata. It is not of uniform thickness throughout, being considerably enlarged just above its inferior extremity, and again in the neck and upper part of the back or dorsal region: to these enlargements much importance has been attached by physiologists, as will appear in the sequel. The chord is divided into two similar halves, on each side of the middle or mesial plane by two lines, one running along the anterior, the other along the posterior surface; these are entirely superficial, at least after the full development of the organ; there are also two collateral grooves on each side, from which the roots of the spinal nerves arise in pairs, thirty on each side, passing out to their destinations from between the long arches of which the canal is formed. Fig. 2, in our first plate, gives a very good posterior view of the nervous centre, with the origin of the spinal nerves. When the chord is traced from the spinal canal into the skull, it is found to retain nearly the same form for about an inch, and to proceed nearly in the same vertical direction; being, however, considerably enlarged towards its upper part, it presents here the appearance of a flattened cone truncated beneath. This is the medulla oblongata of anatomists; and on its surface a further deviation from the cylindrical form is produced by the existence of six eminences:—

Digitized by Google

two on the anterior aspect looking to the basilar process of the occipital bone, which is above and before the large foramen at the base of the skull, by which the chord enters, are termed the pyramidal bodies, one being on each side of the mesial or middle line; they are marked in Plate 2, Fig. 1, by the letters *i*, *i*; two placed further back are the olivary bodies, marked *h* in the same figure; and other two, which look backwards, are known by the name of the restiform bodies; these are at the upper and back part of the medulla oblongata, and contribute to the formation of the cerebellum. Between these restiform bodies, the posterior line of the spinal chord expands into a triangular depression, called the calamus scriptorius, so named by Vesalius, who conceived it to have a resemblance to a writing pen; it is the termination of what is called the fourth ventricle of the brain, and is seen in Plate 3, Fig. 1, marked *m*. The anterior collateral line of the spinal chord ascends, in like manner, on either side, between the pyramidal and olivary bodies; and the posterior collateral line between the olivary and restiform bodies of the side to which it belongs. The medulla oblongata is regarded as composed of six chords corresponding to these six eminences, and designated by the same names; and the spinal chord itself is conceived to be made up of six chords in the same manner, although the evidence, as respects it, is by no means so satisfactory.

The medulla oblongata passes above into the annular protuberance or pons Varolii, well seen in

Digitized by Google

Plate 2, Fig. 1, *d*. This is a considerable eminence on the anterior inferior aspect of the cerebro-spinal axis, convex from side to side, and connected laterally with two large chords, the crura or middle peduncles, which pass into the substance of the cerebellum. From the anterior part of this eminence two chords also emerge, which expand one into the substance of each hemisphere or superior portions of the brain itself; these last are the crura or peduncles of the brain. Immediately above the pons Varolii, and continuous with its substance, except in the middle line, where there is a small canal, are the optic tubercles, or tubercula quadrigemina. These four tubercles, seen in Plate 3, Fig. 1, supporting the pineal gland *g*, are of considerable size, the two anterior being the larger; their convexity is directed upwards, and they constitute the highest part of the cerebro-spinal axis.

The cerebro-spinal axis, then, as we may now see, is composed of the spinal chord, the medulla oblongata, the annular protuberance, and the tubercula quadrigemina; while it is connected with the brain by its peduncles, and with the cerebellum principally by the crura cerebelli or middle peduncles, but also by two other pairs of chords called the restiform chords or inferior peduncles, and by the processus ad testes or superior peduncles; the first are prolongations of the posterior chords of the medulla oblongata into the substance of the cerebellum, and the other proceed from the two posterior optic tubercles to the cerebellum, supporting be-

Digitized by Google

tween them a thin medullary lamina termed the valve of Vieussens.

The cerebellum, which altogether does not much exceed the bulk of an ordinary fist, is placed posterior to the medulla oblongata, occupying the inferior part of the cavity of the skull behind the great occipital hole. Its inferior, lateral, and posterior surfaces are in contact with the concavity of the occipital bone; and, although somewhat sulcated, are smooth and nearly convex: its upper surface, which is of a similar character, though more flattened, is covered with a strong and dense membrane, derived from the dura mater—a membrane of the brain—which, being projected forwards nearly in a horizontal direction from a ridge on the inner surface of the occipital bone, supports the posterior lobes of the brain, while it covers the whole cerebellum and separates it from them. This horizontal membrane is termed the tentorium; and, from its inferior surface in the middle line, a process descends attached posteriorly and inferiorly to a vertical ridge of the occipital bone as far as the great foramen; this is, from its resemblance to the cutting part of a scythe, termed the falx of the cerebellum; it is received into a fissure of that organ corresponding to its depth and extent, and thus divides it, on this aspect, into two lateral hemispheres.

The anterior surface of the cerebellum is deeply notched, corresponding to the medulla oblongata, and constituting with it principally the fourth ven-

Digitized by Google

tricle, which in Plate 3, Fig. 1, has, by an oblique section, been laid open, and marked *l*. The central portion of the organ is narrow, and rises superiorly into a small conical elongation, the superior vermiform process, Plate 2, Fig. 1, *e*; while between the medulla oblongata and the anterior great notch, the inferior vermiform process is seen at *g*. Along the circumference of each hemisphere a fissure extends transversely, to the bottom of which we trace the crura or middle peduncles derived from the annular protuberance. The fourth ventricle, or ventricle of the cerebellum, Plate 3, Fig. 1, *l*, is placed, as above noticed, between the anterior surface of the cerebellum and the posterior surface of the medulla oblongata; while the roof or upper part is formed by the valve of Vieussens, *h*, extending from the vermiform process to the posterior part of the corpora quadrigemina or optic tubercles. This ventricle communicates with the third ventricle of the brain by what is called the aqueduct of Sylvius, already referred to as existing between the annular protuberance and the optic tubercles. And here it is convenient to allude to the parts depicted in Plate 2, Fig. 1, which, after Paxton, displays the base of the brain, deprived, however, of the commencements of the encephalic nerves, which are distinctly seen in Plate 4, Fig. 1 :—*a*, the anterior lobes; *b*, the middle lobes; *c*, the corpora albicantia; *d*, the pons Varolii; *e*, the superior vermiform process; *f*, the cerebellum; *g*, the inferior vermiform process; *h*, the medulla oblongata—the letter being placed

Digitized by Google

on the corpora olivaria; *i*, the corpora pyramidalia; *k*, the posterior lobes; *n*, the pituitary stem.

The inferior surface of the brain is divided on each side into three lobes; the two posterior of these lie over the cerebellum, being supported by the tentorium, already described; the middle and anterior lobes rest on the bones which enter into the formation of the base of the skull. In the space between the lobes, the crura cerebri, already noticed as proceeding from the fore part of the annular protuberance, deserve our first attention. They are two rather thick white chords, which diverge from their origin to lose themselves quickly in the brain. In the substance which connects these crura in the first part of their course, is a triangular depression closed by a thin plate, which forms part of the floor of an internal cavity termed the third ventricle of the brain; but, before tracing the connections of this cavity with the adjacent parts, one or two names belonging to the base of the brain should be explained. The part between the crura, just mentioned, is called the middle perforated plate; before this are two rounded pea-like bodies, the corpora albicantia, Plate 2, Fig. 1, *c*, attached to each other and to the commissure of the optic nerve by a soft grey substance called the tuber cinereum, from the centre of which a thin conical tube, of a reddish colour, descends—the infundibulum; this communicates above with the third ventricle, and terminates in the pituitary gland. The commissure

Digitized by Google

or junction of the two optic nerves is placed just before the parts last described.

It is not difficult to trace from the third ventricle the principal internal parts of the brain. This is situated, as we have said, between the peduncles as they spread out into the substance of the organ; and as these more immediately form the optic thalami, Plate 2, Fig. 2, *e*, and Plate 3, Fig. 1, *c*, and the corpora striata, Plate 2, Fig. 2, *c*, and Plate 3, Fig. 1, *b*, so these are adjacent to the third ventricle; its sides, indeed, if we dissect the brain from above downwards, instead of following it, as we are now doing, from below upwards, seem to be formed by the optic thalami. These bodies are firm, white externally, grey within; their free surface, which is smooth, is in the lateral ventricle, and forms its posterior cornu, Plate 2, Fig. 2, *b*, of which we shall presently speak; their internal surfaces are joined above the ventricle, in what is called the soft commissure. The third ventricle, lying under the corpus callosum, Plate 3, Fig. 2, *c*, communicates with the fourth by the aqueduct of Sylvius, which runs beneath the tubercula quadrigemina, seen supporting the pineal gland in Plate 3, Fig. 1, *g*, and with the infundibulum by a canal termed the iter ad infundibulum. It was here that Des Cartes placed the seat of the soul. When the roof of the third ventricle is destroyed by removing the fornix and separating the soft commissure, it is thrown into one cavity with the lateral ventricles; and if these ventricles are supposed to

Digitized by Google

have been laid open from above by the removal of the thick substance of the upper part of the hemispheres, while the corpus callosum (Plate 3, Fig. 2, *c*) and septum lucidum (Plate 2, Fig. 2, *f*, *d*) are taken away, a distinct view of all the more remarkable parts is obtained.

Our second figure in Plate 2, after Paxton, represents a horizontal section of the cerebrum below the inferior surface of the corpus callosum; *a a*, the anterior cornua of the lateral ventricles; *b b*, the posterior cornua; *c c*, the corpora striata; *e e*, the optic thalami; *f d*, the septum lucidum, extending between the two letters; *g g*, a tissue of blood-vessels called the choroid plexus.

In this figure we see anteriorly the two corpora striata *c c* presenting half their pear-shaped bodies smooth and free, their great ends directed forward, while their small extremities diverge from each other as they proceed backwards, so as to receive between them the optic thalami; between which, however, and the corpora striata is a narrow ribbon termed tænia semicircularis (Plate 3, Fig. 1, *d*).

Our first figure in Plate 3, also after Paxton, exhibits many interesting parts of the brain, which, to describe further in this place, is unnecessary. It shews a horizontal section of the cerebrum, and an oblique division of the cerebellum; *a* is the anterior part of the corpus callosum; *b*, the corpus striatum; *c*, the optic thalamus; *d*, the tænia semicircularis; *e*, the anterior pillars of the fornix cut off at their base; *f*, the commissure of the optic tha-

Digitized by Google

lami; *g*, the pineal gland, situated on four eminences termed the corpora quadrigemina; *h*, the valve of Vieussens; *k*, the arbor vitæ, shewn by an oblique section of *n*, the cerebellum; *l*, the fourth ventricle, terminating in *m*, the calamus scriptorius; *n*, the cerebellum.

In the lateral ventricle, and in contact with the optic thalami, on each side, when the fornix is not destroyed, is seen the pes hippocampi or cornu ammonis, being the termination of a line called the tænia hippocampi or corpora fimbriata, being the plaiting of the margin of the processes of the fornix; further back is the pineal gland, and next in order are the optic tubercles, to the posterior of which the processus ad testes are seen advancing from the cerebellum. To conceive the state of these parts in their entire condition, we must suppose the optic thalami united in the mesial line, or the soft commissure restored; the corpus fimbriatum on each side extended to meet its fellow in the mesial plane, by which junction the fornix, which forms the roof of the third ventricle, is produced, while the septum lucidum, a thin lamina placed vertically over the fornix, is viewed as dividing the one lateral ventricle from the other. We must also suppose that no damage has been done to the corpus callosum (Plate 3, Fig. 2, *c*), under which this septum immediately lies; and further, that the thick superior mass of cerebral substance which crowns the hemispheres is produced anew. We shall thus have the appearance presented which the encephalon

Digitized by Google

exhibits when the calvarium or upper half of the skull has been removed from it,—namely, a grey, convoluted, convex surface, divided by a very deep sulcus, extending from before backwards, into two lateral portions or hemispheres; into this sulcus or fissure the great falciform process of the dura mater, formed like the falx of the cerebellum, is introduced; and at the bottom is seen the white substance of the corpus callosum, just spoken of.

When the dissection and demonstration of the brain is commenced from above and continued downwards, the first step is to slice off portions of the hemispheres on a level with the bottom of their division by the falciform process, and Plate 3, Fig. 2, represents the appearances then presented; *a a a*, the cortical part of the convolutions, with the fissures between them; *b b*, the medullary part forming the centrum ovale; *c*, the corpus callosum.

A deeper section of the cerebrum exhibits the appearances presented in Plate 2, Fig. 2; and a still deeper section is displayed in Plate 3, Fig. 1.

Such, then, is a rude outline of the parts which compose the nervous centre in man. To those who have not opportunities of seeing a dissection of the brain, some assistance will be afforded towards a more perfect conception of the several parts, by the consideration of the successive steps of their development in the earliest period of life; for the very instructive knowledge of which, anatomists are indebted to the researches of the celebrated Tiede-

Digitized by Google

mann, a professor at Hiedelberg, and a short account of which we shall proceed to lay before the reader.

The spinal chord is first formed, and the progress of its development is the more readily discovered, as the posterior part of the long canal in which it is lodged, is, for some time, deficient; the chord ascends into the skull after a time, and the rudiments of the several parts of the encephalon are in succession derived from it.

At the end of the first month of fetal life, nothing but a limpid fluid is seen in the situation which the nervous centre is afterwards to occupy. About the fifth or sixth week a membranous canal, containing a whitish and almost transparent fluid, extends along the posterior part of the spinal column, expanding in the head into a pouch, composed, to all appearance, of several vesicles. Soon after this period the spinal portion extends through the whole length of the vertebral column, composed, at first, of two lateral ribbons of uniform dimensions throughout; these soon unite at their anterior margin, and some enlargement appears next the skull, into which the chord is soon found to extend. From the lowest part of the chord, within the skull, two thin narrow plates afterwards arise, one on each side, so as to rest upon each other and form an arch over the chord, but without, at this time, becoming united. These two plates are the rudiments of the cerebellum; and the arch beneath represents the fourth ventricle. At the same time, two other plates, immediately anterior to these, arise from the chord in

Digitized by Google

a similar direction, rest on each other, and form another arch—the rudiments of the optic tubercles, or tubercula quadrigemina; the arch beneath is the ventricle which in some animals exists throughout life, but which in man and other mammals becomes reduced to a narrow canal—the aqueduct of Sylvius. The anterior part of the chord now exhibits the rudiments of the peduncles of the brain; and from these, which must be regarded as the anterior prolongation of the chord, two rounded bodies, one on each side, afterwards arise, in a manner similar to the origin of the two first pairs of plates, the interval between which corresponds to the third ventricle of the fully developed brain. Finally, two other eminences, still further forward, appear on a similar plan—the corpora striata, the interval between which, though open for a great part of fetal life, becomes closed before birth.

Such is the state of the encephalon towards the beginning of the third month of fetal life; or the parts, the rudiments of which are already formed, are those which constitute the prominent points in the adult, after the upper substance of the hemispheres has been removed, the lateral ventricles laid open, and thrown into one cavity with the third ventricle. There is at this time no corpus callosum or other commissure, no fornix, no appearance of the expansion of the chord called the annular protuberance, and no nerve is discoverable. There is no appearance of hemispheres; although, from the rudiments of the corpora striata, the most anterior

Digitized by Google

processes of the chord, two productions arise curved from before backwards, which are the rudiments of these bodies, after a time to extend backwards, so as to cover the parts already formed in the reversed order of that in which they were respectively produced; or, in other words, they are prolonged gradually into a cap or canopy, by which the lateral ventricles are completed; the germ of the corpus callosum, by which the two hemispheres, before separated, are connected, being discovered in the course of the third month. In the same month the anterior pillars of the fornix appear; and, at a later period, the opposite pillars become joined to constitute the fornix itself, by which the third ventricle is separated from the lateral. In the same month the bodies which represent the optic thalami appear to be prolonged downwards to constitute the infundibulum; the pituitary gland, which is hollow, and communicates by the infundibulum with the third ventricle, is also discoverable; and the rudiments of the corpora albicantia are seen within the peduncles of the cerebrum. Before the end of the third month the olfactory nerves, the accessory of Willis, and some others, have appeared; the first are hollow, and their cavity communicates with the third ventricle through the interval then existing between the corpora striata.

The spinal chord, which, by the junction of the posterior margins of the ribbons of which it was originally composed, has become a tube, begins to shew indications of the two expansions which cor-

Digitized by Google

respond to the origin of the nerves for the pectoral and pelvic extremities; the rudiments of the spinal nerves are also discovered. The connection between the cerebellum and optic tubercles, to become the roof of the fourth ventricle, has also appeared.

In the fourth month, the eminences on the surface of the medulla oblongata are first seen—the pyramidal being discovered before the olivary and restiform. The chord beyond the pyramidal eminences swells into the annular protuberance, and the pineal gland appears. At this period, then, the nervous centre has assumed a character very similar to that which it is to exhibit throughout life.

The nervous centre is composed of two kinds of matter,—the grey or cineritious, and the white or medullary. The grey, in the encephalon, is chiefly placed on the external surface, while the white constitutes the substance of the internal parts; the grey matter, however, alternates with the white in some of the internal parts, as in the thalami and the corpora striata; and in the spinal chord it is placed exclusively within the tube, which at an early period extended through it. Grey matter is also found in the interior of the parts prolonged upwards from the spinal chord, as in the annular protuberance and crura cerebri.

The general structure of the nervous matter is fibrous, that is, composed of globules placed in linear rows. This is more particularly acknowledged of the white matter, and may be seen in the

Digitized by Google

spinal chord as early as the fourth month of fetal life. The recent researches of Raspail and Ehrenberg, support the existence of two distinct kinds of fibres in the white matter, namely, fibres studded with minute knots or globules, and fibres of larger size, distinctly tubular, and contained within a granular matter. The first kind are formed in most parts of the brain and cerebellum, as also in the nerves of the special senses, in the sympathetic nerve, and ganglia; those of the latter belong to the base of the brain, to the crura cerebri, the motor nerves of the skull, and to the spinal nerves, particularly to such as are destined to motion.

The general fibrous nature of the medullary matter, is made obvious by the assistance of such agents as coagulate the albumen which it contains, such as alcohol, dilute nitric acid, a solution of corrosive sublimate, or of alum, and by the action of hot oil of turpentine.

The fibres assume two principal directions,—vertical and horizontal. Vertical fibres are seen in the spinal chord, and they appear to ascend through the medulla oblongata, annular protuberance, and crura cerebri, into the substance of the brain. From the crura they ascend on the outer side of the optic thalami, and thence diverge in all directions to reach the convolutions of the surface. The thalami and corpora striata, are appendages of this vertical set of fibres. The horizontal fibres are formed only in the encephalon; they belong to the corpus callosum and the other commissures, in

Digitized by Google

which they run transversely, and to the fornix and its crura, in which they run antero-posteriorly. The fibrous nature of the cortical or grey matter, is not so distinctly made out. Reil considered it as fibrous, and Raspail and Ehrenberg regard it as differing from the white matter in being more vascular, in the fibres being less regularly arranged and interspersed with a granular matter not disposed in fibres. The view perhaps which Grant takes of it is not far from correct; namely, that it consists of a vascular plexus, in the meshes of which is an irregular granular pulp, assuming more of a regular fibrous arrangement as it approaches its junction with the medullary substance.

The mode in which the convolutions of the surface are produced, is most easily understood from the description given of them by Gall and Spurzheim, who assume that the vertical fibres of the medullary matter which reach the surface of the hemispheres, are of unequal lengths, some stopping short, others proceeding farther, so that the medullary surface, that is, the surface which would be presented, were the external cortical matter with its membrane simply removed, is indented or composed of numerous points and depressions. Again, they say that this membrane—the pia mater—which is much larger than simply to contain the brain, is covered to one uniform depth with grey matter on its internal surface. This large membrane then, they continue, with its lining layer of grey matter, is thrown into plaits or folds which

Digitized by Google

fill up the depressions of the medullary surface, as it spreads over the hemispheres. Little objection can be taken to this description, except that it is not distinctly proved that the prominent medullary points which are introduced between the layers of the grey matter in the convolutions, are prolongations of the vertical fibres of the substance of the organ.

In the cerebellum, are horizontal fibres, particularly in its nucleus; but the greater part of these connect themselves with the cerebro-spinal axis by three columns on each side already referred to,—the superior, middle, and inferior peduncles. From the nucleus also, fibres spread into the laminæ of the surface, where the medullary plates are enclosed between thin layers of grey matter. This disposition of the two kinds of matter which is brought into view by a vertical section of the cerebellum on each side, is seen in Plate 3, Fig. 1.

Albumen appears to be the principal chemical constituent of the nervous substance; it affords, besides, various fatty matters and cholesterine; it also contains sulphur; and, according to Couerbe, phosphorus, on the amount of which, however, according to the same authority, its fitness for the maintenance of its peculiar functions depends.

We come now to the nerves of the human body. These are arranged into the two great divisions of Cerebro-spinal and Ganglionic. The first of these

Digitized by Google

are again divided into cranial or encephalic, and spinal. With regard to the number of the former there is some ambiguity, but it is sufficient for our purpose to describe nine encephalic pairs, and thirty spinal pairs.

Nerves are white, and for the most part cylindrical chords, formed of a more or less considerable number of interlaced filaments connected by cellular tissue. As they recede from their origin, they are divided and subdivided, almost without limit, into more and more minute filaments, until they terminate in different ways, either losing themselves in the tissue of organs, or continued by anastomosis into other nervous filaments; of the latter termination, four varieties have been pointed out: 1. two branches which belong to the cerebro-spinal system unite; 2. branches or filaments derived from the cerebro-spinal system unite with others belonging to the ganglionic system; 3. two branches of the same nerve unite; 4. branches of a nerve of one side unite in the mesial region with branches of the corresponding nerve of the opposite side. As the nerves recede from the nervous centre, the sum of the united diameters of the several branches, greatly exceeds the diameter of the trunk from which they are derived; so that every nerve represents a cone, the apex of which is in the nervous centre, and the base in the organs or parts to which it is distributed. Every nerve is composed of a great number of chords, which again are made up of an indeterminate number of filaments; while both so

Digitized by Google

frequently anastomose with each other, as to form a complete net-work or plexus; and hence, from this constant interlacing, it follows that, in the progress of a nerve, its chords and filaments are no longer distinct as they were at its origin. The size of the component chords of a nerve is by no means uniform, nor does their number bear any fixed proportion to the volume of the nerve itself. A large nerve may consist of many small chords, while a much smaller is made up of a few large chords; or, as the pneumo-gastric, it may be composed of only one grooved chord. The proper sheath or membrane of the nerves is called their neurilema; the olfactory nerve, however, has none, and it is only found round the optic nerve after its commissure.

The encephalic or cranial nerves were formerly, with less propriety, called cerebral; for they are not strictly cerebral, inasmuch as all of them have their origin in the cerebro-spinal axis, or in that part within the skull on which the cerebrum and cerebellum are superimposed. This is seen in our Plate 4, Fig. 1, after Milne-Edwards, which, though somewhat fanciful and incorrect, represents, sufficiently well for our purpose, a vertical section of the brain and cerebellum, with the medulla oblongata, and encephalic nerves. It is needless to add, that A is the anterior, B the middle, and C the posterior lobe of the brain; D the cerebellum, and E the spinal chord; *f* is the divided corpus callosum, which, as we already know, is situated at the bottom of the sulcus, separating the two hemispheres,

Digitized by Google

and beneath which the lateral ventricles are placed; *g* represents the optic lobes. In the following brief description of the nerves, we shall refer to this figure.

The first pair (1) is olfactory passing through a perforated plate in the fore-part of the base of the skull, to supply the organ of smell.

The second pair (2), traced from the optic lobes (*g*), or highest part of the cerebro-spinal axis, and connected with the optic thalami, unite in the base of the skull to form the optic commissure, from which two nerves again proceed, one into each orbit, to spread into the retina, or proper seat of vision in the eye. The two first pairs, then, are nerves of special sensibility.

The nerves of the third part arise near the inner edge of the peduncles of the cerebrum, close to their origin from the annular protuberance; their filaments are distributed to the muscles moving the eye-ball, and a small portion is traced to the eye-ball itself, which probably reaches the iris, the moveable curtain of which the pupil is the centre. In the plate, the third pair is seen arising before the optic nerve, and distributed as above.

The nerves of the fourth pair (4) arise close to the posterior optic tubercles, at the outer margin of the valve of Vieussens; and its origin is seen in the plate immediately below that of the last mentioned nerve. It is the smallest of the encephalic nerves, and distributed to a single muscle of the eye-ball. This nerve has long been supposed to be concerned in movements of the eye expressive

Digitized by Google

of mental emotion, and hence it has been termed the pathetic and amatory nerve; more recently Sir Charles Bell has named it the respiratory of the eye. This name refers to the same property, as it is a part of his theory, that all the nerves of expression take their origin from what he terms the respiratory tract of the nervous centre. Under this view, then, the third pair are nerves of general motion, while the fourth pair are nerves of special motion.

The fifth pair (5) is the largest and most remarkable of the encephalic nerves. It is a symmetrical nerve, belonging to the same order as the spinal; that is, it has two roots, or rather fasciculi of roots, one appropriated to sense, the other to motion. The first set arise from the angle between the annular protuberance and the crura of the cerebellum; the second from the pyramidal chords in the substance of the same protuberance. The first forms a ganglion, called the Gasserian, with which the other has no direct connection. From this ganglion three nerves arise, the highest, or ophthalmic (5 *a*), passes into the orbit to supply the eyeball, the membrane of the nose, and the forehead; the portion of this nerve designed for the eye-ball forms a minute ganglion, termed the lenticular, with which a branch of the third pair is connected before it is distributed to the eye, where it appears to be spent principally on the iris. The second portion of the fifth pair, the superior maxillary (5), is transmitted to the face, through a hole immediately below the eye; it is in this nerve that tic doloureux

Digitized by Google

has its most frequent seat. These first two portions of the fifth pair being derived exclusively from the posterior set of roots, are nerves of sense only; for when they are divided in living animals, no loss of motion, but only loss of sensation follows. The third nerve, derived from the ganglion of the fifth pair, unites with the anterior fasciculus of roots which has not entered the ganglion, to constitute the inferior maxillary nerve (5 *b*), which sends branches to the muscles moving the jaw, forms the gustatory or nerve of taste in the tongue, and the dental nerves of the teeth in the lower jaw. When this nerve is divided, the power of moving the jaw on the side on which it has been cut is lost.

To shew the double origin and distribution of this remarkable nerve, we refer to Plate 4, Fig. 2, for which we are indebted to our friend Dr Handyside, a well-known and eminent teacher of anatomy in the Edinburgh school. The drawing is highly illustrative; and the reader will find it fully described in the references to our plates at the beginning of the volume.

The sixth pair (6) are motor nerves, arising along the sides of the pyramidal eminences of the medulla oblongata, and becoming free at the groove between it and the annular protuberance. They supply that muscle of the eye-ball which draws the organ outwards.

The seventh pair (7) is more complex; it consists of two portions, the first a nerve of special sense, the auditory or portio mollis of old authors going to

Digitized by Google

to the labyrinth of the ear; the other the portio dura, a respiratory nerve, in Bell's system, and certainly a motor nerve, for the face; the first portion arises over the restiform body, in what is called the floor of the fourth ventricle, so it must be regarded as coming from the posterior columns of the cerebro-spinal axis; while the second portion, the true facial, becomes free just behind the posterior edge of the annular protuberance a little to the outside of the origin of the sixth pair, and somewhat anterior to the origin of the auditory. It is, however, still uncertain whether it should be ascribed to the anterior or middle columns of the axis, the latter of which Bell considers as in the respiratory tract.

The eighth pair is very complicated; it consists, according to the most usual arrangement, of three parts; one which comes upwards from the side of the cervical portion of the spinal chord into the skull, to accompany the other two portions which are altogether encephalic outwards, to be distributed on two muscles concerned in the elevation of the ribs in the act of inspiration; this is the accessory nerve of Willis, termed by Bell the respiratory of the neck; 12 in our plate gives some idea of it. The least important of the encephalic portions, named glosso-pharyngeal (9), destined as its name indicates for the tongue and adjacent parts, arises from the groove between the restiform and olivary eminences immediately above the origin of the pneumo-gastric or par vagum (10), the most important portion of the eighth pair, supplying the

Digitized by Google

pharynx, larynx, windpipe, gullet, lungs, and stomach, and communicating with the nerves of the heart and those of the digestive organs in general. Much difficulty still attends the determination of the true theory of this nerve: Bell ranks it among the respiratory.

The ninth pair (11) is plainly a motor nerve, and its origin corresponds with this circumstance, being derived from the groove between the olivary and pyramidal bodies. It supplies the tongue, in which it is the nerve of motion, and also some of the muscles concerned in deglutition.

Although in the above sketch we have made but nine pairs of encephalic nerves, many anatomists have made more; some dividing our seventh pair into two distinct pairs, and others our eighth pair into three pairs.

The spinal nerves, as already noticed, amount to thirty pairs; they arise, as is seen in Plate 1. Fig. 2, from the sides of the spinal chord by two roots, the anterior being smaller than the posterior. Each root is formed by a number of filaments, distinct at their commencement; they traverse a space of the spinal chord, before they issue, by the intervertebral holes in which they unite, and before which union the posterior root has formed a minute hard enlargement or ganglion of a grey colour and oval form. From these nerves are formed those which supply the diaphragm or midriff, an organ essential to the function of respiration, the upper extremities, the muscles of the back and abdomen, and the lower

Digitized by Google

extremities; besides which, they communicate with the ganglionic nerves which descend on the fore part of either side of the spinal column.

The ganglionic system next arrests our attention. Ganglia are minute nervous centres from which filaments proceed to anastomose with neighbouring nerves, or to become lost in the substance of adjacent organs. They are met with in the trunk, back, and head only, the extremities exhibiting no traces of them. They communicate with each other throughout, and all present the same definite character. Their general appearance is as delineated in Plate 5, Fig. 1; although they vary considerably in form and magnitude, they always appear as reddish or greyish bodies deeply situated in the cellular tissue, and possessed of no particular envelope; they are highly vascular, and believed to be composed of a multitude of minute filaments; they are hardened by moderate boiling. The nervous filaments which proceed from the ganglia communicate with the cerebro-spinal system of nerves very freely, connect the ganglia with each other, and follow the arterial system throughout all its ramifications.

The largest and most remarkable ganglion is the semilunar, situated on the fore part of the aorta or great arterial trunk, in the region of the stomach. It is rather, however, a collection of ganglia, than a single ganglion, the number of its parts being variable. There are always two principal portions, a

Digitized by Google

right and a left, and these two are always much larger than the others, which are less uniformly present. These several portions are united by a great number of nervous filaments, and the same filaments in their passage anastomose with each other. This collection of ganglia and filaments are properly called the solar plexus; from it a plexus of nerves is transmitted to the liver, another to the spleen and pancreas, and a third, joining some branches of the pneumo-gastric nerve, to the stomach. From the lower part of the solar plexus filaments proceed, which, joining other filaments derived from the hepatic and splenic plexuses, descend to constitute the superior and inferior mesenteric plexus, the renal plexus, and the hypogastric plexus, from which the bowels, kidneys, and organs of the pelvis are supplied. Plate 5, Fig. 2, exhibits, after Paxton, some of the principal nervous ganglia and plexuses of the thorax and abdomen on the left side, and the pneumo-gastric nerve on the same side; *a a*, being thoracic ganglia; *b*, the pneumo-gastric nerve; *c*, a branch of the former, called the inferior laryngeal or recurrent, curving round the arch of the aorta; *d*, the œsophageal plexus; *e*, the pericardium; *f*, the lungs; *g*, the diaphragm; *h*, the spleen; *i*, the stomach—the two last named organs being turned to the opposite side to shew the distribution of the nerves; *k* is the kidney; *l*, the abdominal aorta; *m*, the semilunar ganglion and solar plexus, the latter radiating to all the divisions of the aorta; *n*, is the splenic plex-

Digitized by Google

us; *o*, the pancreas; *p*, *p*, *p*, the lumbar ganglia; *q*, the obturator nerve; and *r*, the pulmonary plexus.

Another division of the ganglionic system, is the great sympathetic nerve. The chain of ganglia which, with their connecting filaments, constitute this nerve, extends from the base of the skull, on each side, along the fore and lateral parts of the vertebral column, to the extremity of the sacral bone. In the neck there are three ganglia; in the back twelve; in the loins five, and lower down four or five called sacral ganglia; finally, on the upper part of the coccygeal bone, or the lowest of the spine, the filaments, from each side, unite in a small ganglion called the ganglion impar. The filaments from the cervical ganglia communicate with the spinal nerves of the neck, and, moreover, constitute the cardiac nerves, which unite to form a ganglion and plexus near the root of the aorta, from which the nerves proceed along with the coronary or proper nourishing arteries of the heart to be distributed in the substance of the organ. From five or six of the inferior dorsal ganglia, a nerve on each side arises to descend with the aorta into the abdomen, and to communicate with the great semilunar ganglion already described. From the lumbar and sacral ganglia, branches proceed to connect themselves with the several abdominal and pelvic plexuses derived from the great solar plexus. From the superior cervical ganglion two rather large, soft, reddish filaments ascend into the canal of the internal carotid artery, around which they form a plexus send-

Digitized by Google

ing filaments to several parts; one of these unites with the vidian nerve derived from the second portion of the fifth encephalic pair; several unite with the sixth encephalic pair; and another goes to join the ophthalmic portion of the fifth and its nasal branch; by means of this filament a communication is established between the first cervical ganglion and the lenticular ganglion of the orbit.

Such is a slight outline of this important ramification of the nervous system.

It is not compatible with the design of this treatise to enter into a detailed account of all that is plausible, probable, or ascertained with respect to the function of the system, a sketch of which has now been exhibited; yet it will not be out of place, with a view to the immediate object before us in this chapter, namely, the bearing of the anatomy of the nervous system on the difference between instinct and reason in animals, to notice a few of the more remarkable facts in evidence of the special endowments of particular parts of the nervous system, or of the connections which have been established by observation and experiment between the existence of certain forms of development and the exercise of corresponding acts or offices in the animal economy. It is true that all or nearly all of these facts have not been ascertained by direct experiments upon the human body, but they are justly inferred to be true of it, because true of animals of a similar character. There is no just ground for

Digitized by Google

objecting to connect these with the nervous system of man; nor is any thing sought in the present case in placing them here rather than elsewhere, but the simple convenience of arrangement.

Although many metaphysicians have delighted to inculcate that the nervous system should be regarded as one organ, spreading indeed over the body, yet simultaneously affecting in all its parts when any function is exercised; yet the very opposite characters of the two acts in which the nerves are least equivocally concerned, namely, sensation and motion, had led others at an early period to conjecture that the nerves of sensation must be different in substance from those of motion, although, as they imagined, both might be bound up in the same sheath. The truth of this conjecture has been verified in our own day principally by the researches of Sir Charles Bell; and without entering upon the intricacies of the subject, or touching on certain points still under controversy, let it suffice to say, that two distinct sets of nerves have been established as concerned respectively in motion and in sensation. Here, then, we have the first step in assigning different functions to different portions of the nervous system; and in respect to which it should be noticed, that the irritation of certain parts of the nervous centre in the living body is uniformly followed by muscular contractions, while no such effects attend the irritation of certain other parts. Thus the irritation of the cerebro-spinal axis pro-

Digitized by Google

duces such contractions, while that of the brain proper and the cerebellum does not give rise to any such effect, unless in so far as irritation of the axis may accompany it. Again, it is established by numerous experiments that no part of the nervous centre, higher than the optic tubercles, is essentially concerned in sensation, that is, that neither the brain proper nor the cerebellum is essential to that act. It is proved also, that, at least in many animals, the optic tubercles are the only parts of the encephalon essential to the sensations concerned in vision. It appears also, that, while sensation belongs to the cerebro-spinal axis, or rather to certain parts of it, the recollection of sensations, the association of them, and other intellectual acts are essentially dependent on the brain, all trace of such operations being lost when the cerebral lobes are removed, although the evidence of the continuance of sensation be still perfect. The destruction of the cerebellum does not interfere with the power of sensation or with intellectual acts in general, but is followed by the loss of the power of regulating the motions of the limbs in particular; or the cerebellum appears to be the organ through which an animal recollects muscular sensations, as the cerebrum is subservient to the recollection of other sensations and mental acts in general.

But it is time to close this brief illustration of the separate endowments of different parts of the nervous system, and the subject may be properly broken off with a reference to the singular anoma-

Digitized by Google

lies of volition produced by the section of certain parts of the encephalon. Thus, when the bands of medullary matter, passing from the peduncles of the brain through the corpora striata to the hemispheres, are divided in the living body, the animal acquires an irresistible tendency to move forwards. Again, when the cerebellum is cut through, the tendency is to motion backwards; and when the middle peduncle of the cerebellum is cut on one side, the animal rolls over to the same side. These and many other analogous effects must depend on the usual influence of the cerebrum or cerebellum, originating in recollected sensations or other mental operations, such as produces muscular motions through the medium of the cerebro-spinal axis, being interrupted and disturbed by the lesion which has taken place.

Digitized by Google

SECTION II.

THE NERVOUS SYSTEM IN VERTEBRATE ANIMALS BELOW MAN.

What Aristotle believed to be the principal difference that distinguishes the nervous system of man from that of the other vertebrate animals, the greater proportionate size of the brain compared with the bulk of the body, is found, although generally correct, to be liable to some exceptions. Thus among mammals, some of the quadrumana, particularly a few of the sapajous or American apes, have, in the adult state, a cerebrum as great in comparison to the bulk of their bodies, as the brain of the human infant to its body, which is considerably beyond the proportion in adults. Again, the brain of one species of dolphin among the cetacea, compared with its body, exceeds the proportions of the human brain. Exceptions still more remarkable, are found among birds, principally, if not exclusively, among the smaller species. Thus in the house-sparrow, the proportionate size of the brain equals its proportion in the infant state of man; while in the canary bird it considerably exceeds it. It does not appear that any exceptions of this kind occur among reptiles and fishes. Notwithstanding these exceptions, which are nearly confined to small animals,—in which, as a rule, the brain is proportionally more developed than in large,—the generally greater comparative size of the human brain

Digitized by Google

must be regarded as an important circumstance of difference in our reasonings with respect to the nervous system. A distinction, to which no exception has yet been stated, was pointed out by Söemmering, namely, that the brain of man bears a greater proportion to the bulk of his nerves than the brain of all other animals to the bulk of theirs. This fact at once marks out the superior development of the brain as the characteristic of man, since the relation of the several parts of the same system affords a far more just standard of measurement than the size of the body—the aggregate of many systems, the development of each of which, in different animals, is influenced by many circumstances of an accidental nature.

The cerebrum of man is estimated at $\frac{1}{22}$th, $\frac{1}{25}$th, $\frac{1}{30}$th, in the progress of life from birth, and finally, in the adult at $\frac{1}{35}$th of the weight of his body; and the cerebellum is said to equal $\frac{1}{9}$th of the mass of the cerebrum, while, with two singular exceptions, the cerebrum is much more developed, compared to the cerebellum, than in other animals. Thus in the dog the cerebellum is $\frac{1}{8}$th of the bulk of the cerebrum; in the cat $\frac{1}{6}$th; in the sheep $\frac{1}{5}$th; in the beaver $\frac{1}{3}$d; and in the mouse $\frac{1}{2}$th. The ox, on the contrary, has a cerebellum bearing the same relation to its cerebrum as the two organs bear to each other in man; and there is further a very extraordinary and inexplicable anomaly in the saimiri, an American sapajou, in which the brain is to the cerebellum as 14 to 1, or the cerebellum is

Digitized by Google

but $\frac{1}{14}$th of the bulk of the cerebrum. In the rest of the quadrumana, the cerebellum is more developed in comparison of the cerebrum, as respects man, just as it is in other tribes of animals.

The cerebro-spinal axis, taken as a whole, is much more developed proportionally in other animals than in man. Thus the spinal chord is uniformly of greater size compared to the cerebrum, and the medulla oblongata is also more developed in general; an exception, however, has been pointed out in this respect in the dolphin. The annular protuberance is, however, more developed in man, or it is developed in the same ratio as the cerebrum, while on the contrary the optic tubercles are least developed in man of all the vertebrata. In all mammals these are four in number, the two anterior being of greater size in herbivorous tribes, the two posterior in the carnivorous; and in man the anterior but slightly surpass the posterior in magnitude. In the human fetus, and in the fetus of mammals in general, there are but two optic tubercles, from the absence of the transverse groove. At this period they are ventricular, owing, as we have remarked, to the great size of the opening which is to become the aqueduct of Sylvius. In birds, reptiles, and fishes they remain throughout life in this state, being only two in number and ventricular. In fishes they constitute almost the whole encephalon, and were till lately mistaken for the optic thalami. In reptiles their proportional development is somewhat less than in fishes;

Digitized by Google

while it is greater in birds. In birds it is greater than in mammals; while among the latter it is least in man. They are developed then in the inverse ratio of the cerebrum; but in the direct ratio of the optic nerves.

Before leaving the cerebro-spinal axis, certain peculiarities of form, connected with the existence or absence of extremities and of a tail, must be noticed, as illustrative, in a remarkable manner, of the extension of development in the nervous system, with extension of function and *vice versâ.* It has been already observed, that the spinal chord exhibits two enlargements, one near its termination, corresponding to the origin of the nerves of the pelvic extremities; the other, at the lower part of the neck and upper part of the dorsal region, corresponding to the origin of the nerves of the pectoral extremities.

It has been observed that human monsters, born without legs or arms, do not exhibit these enlargements. In those mammals which have no pelvic extremities, as the cetacea, there is no posterior enlargement on the spinal chord. In those birds which live on the earth, as our domestic fowls, those which climb trees, and more particularly in the ostrich, the posterior enlargement much exceeds the anterior in magnitude; while, on the contrary, in birds which are much on the wing, the anterior enlargement is of surprising size. In the ophidean reptiles, or those destitute of extremities, the spinal chord does not swell at all in this manner. In the

Digitized by Google

larva of the frog,—the tadpole,—the spinal chord is of uniform thickness, until the metamorphosis into the perfect state commences, and limbs begin to sprout out, when these enlargements arise. In fishes the enlargement in this part of the nervous centre is less conspicuous, but corresponds to the place of the fins. In those which have no ventral fins or the apodes of naturalists, there is no enlargement; in the jugular fishes, or those which have the ventral fins placed before the thoracic, the enlargement is in the cervical portion of the spinal chord; in the pectoral fishes, in which the ventral fins are directly under the thoracic, the enlargement is in the dorsal or middle region of the chord; and in the abdominal fishes, in which the ventral fins are behind the thoracic, the enlargement is in the abdominal region of the chord. In the flying-fish, in which the pectoral fins are greatly developed, there are enlargements of the spinal chord corresponding in magnitude and number to the detached rays of the fins; while in the electric fishes there is a considerable enlargement, corresponding to the nerve which supplies the electrical apparatus.

'Again, in the human fetus, before the third month, the spinal chord is extended to the extremity of the coccygeal bone, and at that time this bone is prolonged into a true tail; after this period the chord becomes suddenly shortened, so as to terminate in the upper part of the lumbar region; and when this change takes place, the coccyx becomes reduced in dimension by absorption, and the cau-

Digitized by Google

dal prolongation disappears; if, however, from any accidental cause, interfering with the energy of development at this period, the shortening of the spinal chord should be arrested, then the infant is born with a tail, as has been observed in many instances.

In bats the same thing occurs; they have at first a tail, which disappears as the spinal chord rises in the canal. Further, a similar law is observed as regards animals with long tails as compared with those that have short tails; the more the spinal chord rises in the canal, the shorter the tail,—remaining prolonged in such as have long tails throughout life. Sometimes the frog retains the tail which characterises it in the larva state; and, when this is the case, it is found that the spinal marrow has failed to ascend in the canal, in accordance with the ordinary law which regulates the transition to the perfect condition.

There is thus, then, in these respects, the most obvious connection between the particular development and the particular action which belongs to the animal; nor is it to be doubted but that an analogous correspondence exists between the development of the brain and cerebellum, and the functions to which they are subservient, although this part of the subject we are by no means able to pursue in a manner so satisfactory. No sufficiently just standard of comparison, either as respects the degree of intelligence and instinct possessed by different ani-

Digitized by Google

mals, or as respects the relative development of certain parts of their nervous system has yet been established. The actual size of the parts composing the brain and cerebellum, or their size as compared to the bulk of the body, is evidently a very rude kind of measurement; and a perfect knowledge of the relative size of all the parts in every animal is still far from being attained, although the value of what has been already ascertained gives promise of the greatest success by this species of investigation.

While the size of the cerebrum, as compared to the bulk of the body, varies very much in mammals and birds, without any distinct reference to the degree of intelligence in the animal, still the connection between its development, even as estimated by this imperfect standard, is supported by some facts remarked of these two orders, and much more uniformly by what is observed of the two other orders of the vertebrata, in which the small development of the cerebrum is not more remarkable than their obvious inferiority in intelligence. Thus, to take a few examples illustrative of both positions here referred to:—the brain of the quadrumana varies in different species from $\frac{1}{22}$th to $\frac{1}{105}$th of the bulk of the body; in the bat it is $\frac{1}{96}$th; in the mole $\frac{1}{36}$th; in the bear $\frac{1}{168}$th; in the dog from $\frac{1}{47}$th to $\frac{1}{305}$th, in different varieties; in the fox $\frac{1}{205}$th; in the wolf $\frac{1}{230}$th; in the beaver $\frac{1}{290}$th; in the rat $\frac{1}{76}$th; in the mouse $\frac{1}{43}$rd; in the elephant $\frac{1}{500}$th; in the wild boar $\frac{1}{672}$th; in the ox $\frac{1}{860}$th; in the sheep

Digitized by Google

$\frac{1}{351}$st to $\frac{1}{192}$th; in the horse $\frac{1}{400}$th; in the ass $\frac{1}{254}$th; in the dolphins $\frac{1}{25}$th, $\frac{1}{36}$th, $\frac{1}{66}$th, $\frac{1}{102}$th, in different species; in the sparrow $\frac{1}{25}$th; in the canary bird $\frac{1}{14}$th; in the eagle $\frac{1}{260}$th; in the goose $\frac{1}{360}$th. But among reptiles mark the prodigious change; in the turtle $\frac{1}{5688}$th; in the tortoise $\frac{1}{2240}$th; though in the frog as high as $\frac{1}{172}$th; also in the shark $\frac{1}{2496}$th; in the pike $\frac{1}{1305}$; in the tunny $\frac{1}{13450}$th.

According to Serres, the degree in which the crura cerebri diverge anteriorly to the annular protuberance, together with the size of the third ventricle and the development of the optic thalami, are the best criteria of the amount of intelligence possessed by an animal. If this rule prove to be correct, it will most probably be found to resolve itself into some other less obscure character.

The particular parts, then, of the brain which appear to be most developed in man are the convolutions of the hemispheres, the corpus callosum, the corpora striata, and the optic thalami. The fornix and pes hippocampi attain their highest development in some of the mammals, but not in man. The convolutions exist only in some of the highest orders of the vertebrata; the corpus callosum is peculiar to mammals; the lateral ventricles do not exist except in the same order of animals, and no animal except man and the dolphin (*Delphinus Delphis*), is known to have three horns, as they are barbarously termed, in these cavities. The corpora striata are developed in the direct ratio of the cere-

Digitized by Google

brum itself, or are greater in man and the higher animals; and there are none in birds, reptiles, and fishes. The optic thalami are developed in the direct ratio of the brain in mammals, birds, and reptiles; in fishes they do not exist. The fornix is not found in reptiles and fishes; it is deficient also in most birds; while in some, as in the parrots and eagles, a rudiment of it is discovered. In mammals, on the contrary, it is constant, and most developed in the Rodentia, as in the rabbit, squirrel, and beaver; it is less developed in the Ruminantia, still less in the Carnivora, Quadrumana, and Man. The cornu ammonis does not exist in birds, reptiles, or fishes; and among mammals its development obeys the same law as the fornix. The pineal gland is found in all the vertebrate animals,—mammals, birds, reptiles, and fishes.

The cerebellum consists in fishes of two distinct portions,—a middle lobe, connected with the optic tubercles, and lateral layers, proceeding from, or continuous with, the restiform bodies. These two portions are insulated and disjointed throughout the whole order of fishes. The same are the elements of the cerebellum in the higher orders of animals; the superior vermiform process, connected in all with the optic lobes, represents the first, while the hemispheres continuous with the restiform bodies represent the others. These two portions of the cerebellum should be regarded as distinct, even when continuous the one with the other, as in the

Digitized by Google

higher orders; they are developed uniformly in the inverse ratio of each other.

It would be tedious to enter on the variations of the nerves in the different orders of vertebrate animals; the general plan on which they are distributed, both as respects the cerebro-spinal and ganglionic systems, is the same, the varieties being dependent on the variations in the existence and the development of organs subservient to the habits of the several orders of animals.

Digitized by Google

CHAPTER IV.

THE NERVOUS SYSTEM IN THE AVERTEBRATED ORDERS OF ANIMALS.

It has been a favourite doctrine with many physiologists, that irritability, in its limited signification, or as denoting the susceptibility of movement or contraction on the application of a stimulus, is independent of the nervous power. This property they conceive to be inherent in particular tissues, as in the muscular fibre of animals and certain fibres of plants; and they have been accustomed to support this doctrine more especially by a reference to the supposed absence of nervous matter in the lowest orders of animals. The actions of these, they contend, result altogether from irritability; that is, the movements of their organs are determined by the direct application of stimuli from without. Thus in such animals inhabiting the water, substances, it is conceived, are brought into contact with their prehensile organs, and stimulating them to contract, are detained and brought within the reach of the assimilating powers of the animal; and so they reason of the other actions belonging to such animals. This doctrine, however, appears to maintain itself rather from the difficulty of refuting it than from any considerable weight of positive evidence in its favour. While, however, there are

Digitized by Google

some animals so passive in their habits that such an irritability might be deemed adequate to explain all their phenomena, it has been found that even in many of these a nervous system exists, while in many others equally low in the scale of life, in which as yet no indications of a nervous system have been detected, the actions are so lively, as plainly to imply sensibility, and, in consequence, the existence of a nervous system. As the irritability of a part, in its limited signification, denotes a susceptibility in that part of movement on the application of a stimulus, so sensibility in a part denotes a property in that part of transmitting impressions made on it so as to affect a more or less distant internal organ; which organ in turn may become a centre of excitement through other nerves to the moving organs of the body in general. An animal, then, which is governed exclusively by irritability, must be purely passive in its nature, since no act can occur in any of its parts or organs, except when an external stimulant has come into direct contact with some one of them; while on the contrary, in an animal possessed of sensibility, an external stimulus can give rise to a long series of acts in organs or parts disant from that to which it was applied. Thus by an external agent, one external part receives an impression; this impression is followed by an affection of the nervous centre; this again is succeeded by the muscular contraction of some other part or organ supplied with nerves from the centre; but this contraction is itself a new source of impression to the

Digitized by Google

sensibility of that part, which, as in the case of the first external agent, becomes the cause of a new affection of the nervous centre, from which a new series of the same changes may proceed to an indefinite extent.

It is but a few years since a nervous system was denied to the whole order of Zoophyta; more minute anatomical investigation, however, has demonstrated how erroneous was this inference; and now its presence is acknowledged in most of the sections of that order, and it has more recently been discovered by Ehrenberg even in the Infusoria. It is found in the actinia or sea-anemone, in the medusa or sea-blubber, and is very distinct in the star-fish and echinus or sea-urchin. If, then, it exists demonstratively in animals so sluggish as these, is it possible to deny it to others full of life and activity, such as the cercariæ, which are distinctly sensitive to light, possess an acute sense of taste, distinguish, pursue, and seize their prey, while they avoid impinging upon each other, as they swim in myriads in a drop of water? From such evidence, then, the fair conclusion seems to be, that a nervous system exists throughout the animal kingdom; though it may be, that, besides its transparency in most such animals, the additional obstacle to its discovery exists that it is diffused and mixed up in one homogeneous mass with the general tissue of the body.

The simplest form of the nervous system in the lower animals of the avertebrate division, is a series

Digitized by Google

of minute nervous knots or ganglia, connected by nervous filaments or commissures; while the proper nerves that proceed to the periphery of the body, arise, not from the commissures and ganglia indifferently, but from the ganglia only, as seen in Plate 6. Fig. 1. representing the nervous system in the Beroe pileus; in which it is disposed around the mouth, at the lower extremity of the body in form of a double filament with eight small ganglia. In the well-known echinodermatous animal the star-fish, a series of ganglia are placed around the central mouth, one opposite to each ray; these are connected by a nervous chord into a complete circle, and from each ganglion a nerve is transmitted to the opposite ray, while two other nerves pass inwards from each to be distributed about the gullet within the disk of the animal. (*Plate* 6, *Fig*. 2.) On a very similar plan the nervous system is developed in the sea-urchin, in the medusa or sea-blubber, and in the actinia or sea-anemone.

In the entozoa or intestinal worms which belong to the Zoophyta of Cuvier, the nervous system should perhaps be considered as less developed. In the *ascaris*, for example, (*Plate* 6, *Fig*. 3.) it is a simple chord, hardly exhibiting, in its course, any thing entitled to the name of ganglia; this chord, however, separates into two columns above to embrace the gullet, and lower in the body to encircle the female organ of generation. In the animals of this order, which adhere to the external surface of others, the system is more developed, forming two chords, one on each side of the mesial plane.

Digitized by Google

As we ascend from the zoophyta, in Cuvier's arrangement, the Insecta stand next; yet it is more convenient to consider before these the annelida or red-blooded worms; which present as great a variety in the development of their nervous system, as in that of their bodily frame. In the planariæ, and in the simplest of the aquatic worms, traces of a nervous longitudinal chord are perceived with difficulty; and even in the naiads and some of the nereids, the central chord is as simple as in the ascaris and other intestinal worms. Ganglionic enlargements are hardly discovered even in the more developed air-breathing earth-worm, along the middle chord, though numerous lateral nerves extend to their highly moveable segments and very sensitive skin, and two encephalic ganglia embrace the gullet at their anterior extremity, (*Plate* 6, *Fig* 4). When the body of the annelida acquires a greater lateral development, as in the leech or the sea-mouse, the nervous columns and ganglia become more conspicuous. The ganglia in the leech are about twenty-five in number; and are placed closer to each other in the anterior part of the nervous column than in the posterior; or there is here an indication of that nervous concentration, which characterizes the higher orders of the articulata. Throughout this order, then, there is a remarkable illustration of the uniform connection between the development and the action of parts, and the complexity of the nervous system.

Digitized by Google

In Insects, the general character of the nervous system is still the same, but more developed; while its successive changes may be traced from the larva state through the pupa to its perfect maturity in the imago or complete insect. In the larva state, the nervous column shews a development very similar to that in the annelida, or it is often a nearly simple cylinder, without any conspicuous enlargement. Some insects, as the myriapods, preserve this helminthoid form of the nervous system in the mature state, and the simplicity of their outward form, and the imperfection of their internal organs, are in accordance with this inferior development of their nervous system.

The distinct distribution of certain nerves, derived from the nervous centre even in the lowest tribes, as in the star-fish, to the organs of locomotion, and of others to the organs of sensation and various internal parts, seemed to point out, from the first, the same division into motor and sensific portions in the avertebrate as in the vertebrate tribes. In insects, however, this distinction becomes altogether unequivocal, as might be expected in animals in which the motor power acquires so extended a development. The abdominal nervous columns of insects, were long since correctly regarded as corresponding to the cerebro-spinal system of the vertebrata; or their nervous system corresponds at once to the ganglionic nerves and nervous centre of the same animals. There are generally at first thirteen pairs of approximated ganglia correspond-

Digitized by Google

ing with the original segments along the middle of the ventral surface, and the gullet penetrates the nervous columns between the first and second pairs of ganglia, or the first pair only are supra-œsophageal, or cephalic. The ganglia at first are nearly at equal distances and of equal sizes, as in the worms; but as the animal advances, the ganglia and columns of opposite sides approximate, and become concentrated in a longitudinal direction, so as to become accumulated towards the place where, in the adult state, nervous power is more required. The change in the development of the nervous system in the progress of an insect, is proportioned to the degree of alteration produced on it, as its metamorphosis proceeds and is completed. In the larva state, the œsophageal ring is broader, corresponding to the extreme voracity of the animal in that state,—a caterpillar being computed to devour and digest three times its own weight of aliment in twenty-four hours. In Plate 6 is exhibited the respective conditions of the nervous system, as described and figured by Herold, in the *Papilio Brassicæ*, or common cabbage butterfly, in the states of larva, Fig. 5; pupa, Fig. 6; and imago, Fig. 7.

It was in the arachnida, for example in the scorpion, that a continuous motor tract along the surface of the nervous column was first pointed out by Treviranus and Muller; it is seen in their figure (Plate 7, Fig. 1.), running by the side of the ganglia. As it lies over the sensific, it does not correspond in place to the motor tract of the cerebro-spinal axis

Digitized by Google

of the vertebrata, in which it is formed by the anterior or inferior columns. This, however, is but a part of a general law of inversion as to the position of the nervous system in the articulata.

The development of the nervous system in the whole tribe of arachnida, well accords with the activity of their habits, and the energy of their functions in general.

In the Crustacea, the nervous system exhibits a variety of character, not less remarkable than answering to the diversity of form and function observed in the order; in some it hardly exceeds its condition in the lowest worms, while in others it approaches to the development which belongs to the molluscous animals. The same tendency to concentration of the nervous system, as it becomes more developed, is observed here as in the insecta. Plate 7, Figures 2, 3, 4, and 5, grouped from Audouin, Edwards, Succow, and Grant, exhibit the nervous system in the Talitrus locusta, the cymothea, the lobster, and the maia.

In the molluscous animals of all the avertebrata, the nervous system attains the greatest development; yet a difficulty immediately strikes us here, for many of the molluscous tribes appear among the most sluggish of the whole chain of animals; and it seems difficult to admit any accordance between function and development, when we find the nervous system of an oyster, mussel, whelk, or limpet, placed above that of the industrious bee, and the provident ant. The mollusca, however, do not

Digitized by Google

so much form a group in which throughout, the nervous system is more highly displayed than in the zoophyta and articulata, as a group in which that system assumes a new type; which, in the least evolved state, should not be considered as more perfect than that of the articulata, though, in the progress of development, as the animals grow in structure and function, it undoubtedly stands superior to that of the other avertebrated orders, and makes a close approach to the state in which the same system is found in the vertebrated classes. Plate 8, Fig. 1, exhibits the nervous system in the common mussel. We see two large white ganglia placed on the lateral parts of the mouth (*a*, *b*), and sending numerous branches to the lips; two of which often form a distinct supra-œsophageal or encephalic ganglion, after encompassing the gullet; and two others form a double ganglion just below the first pair. From the same ganglia nervous columns proceed backward along the inferior surface of the abdominal cavity, to the base of the muscular foot, where the middle pair of ganglia (*c*, *d*) are placed. These latter vary much in size, according to the magnitude of the foot which they supply. The columns being continued backwards, form on the inferior surface of the great abductor muscle of the valves, a third pair of ganglia at *e*, varying in size with the muscle, and sending nerves to the posterior part of the trunk and the adjacent organs. From the large nerves (*f*) branches are traced to the gills.

Digitized by Google

It would be tedious to trace the successive steps by which this system is unfolded through the several orders of this great class, from the acephala, to which the mussel belongs, through the cirrhopoda, brachiopoda, gasteropoda, and pteropoda, up to the cephalopoda, in which the development of the nervous system comes nearest to that of the vertebrata; since the only conclusion to be drawn from these anatomical descriptions, namely, that every advance in function is accompanied with a corresponding advance in development, has already been sufficiently illustrated. A slight reference to the state of this system in the highest of the mollusca and of the avertebrate tribes, will form a proper termination to this sketch of the nervous system. In these the gullet still perforates the brain, as in all the inferior classes, but the greatest part of that organ, and of the symmetrical columns produced from it, are, in them, situated above the alimentary canal. The brain is enclosed in a distinct cranium; many symmetrical ganglia are formed both before and behind that organ; and sympathetic ganglia appear in the abdominal cavity. Plate 8, Fig. 2, after Chiaje, of the skull of the argonauta, laid open from behind, will give some idea of its development. The brain (*a*) is of a roundish form, and descends to encircle the gullet (*i*); it gives off the large optic nerves (*g*) which perforate the skull to reach the pedunculated eyes. From the brain also are derived the separate great symmetrical co-

Digitized by Google

lumns (*b*, *b*), which are directed backwards to the parallel ganglia (*c*, *c*). When the supra-œsophageal ganglion and the œsophagus are removed, the great lateral sub-œsophageal pedal ganglia (*f*) are found to send nerves (*d*, *d*, *d*, *e*, *e*), along with the bloodvessels, to ramify on the canal of the arms.

Digitized by Google

CHAPTER V.

OF IRRITABILITY IN PLANTS AND ANIMALS.

THE simplest faculty possessed by organized beings, plants as well as animals, is IRRITABILITY, or, in its largest sense, that susceptibility of being acted upon, otherwise than merely chemically or merely mechanically, by various agents, such as heat, light, air, aliment, and the like, so as to evince various phenomena, which, for the sake of distinction, may be called vital: it is by the possession of this faculty or susceptibility that such beings are distinguished from inorganic, or mineral substances in general; and it is by the display of these phenomena that Life, in its simplest state, exists. Life, then, and irritation, or irritability in action, are synonymous terms; it implies certain motions characteristic of organized beings in general, but not such as are either instinctive or rational, although, in their character and results, they are often equally, if not more wonderful than either. It is proper to be aware, however, as we have before hinted, that, by some physiologists,—for example, by Dr Good and others, who believe in the existence of a Living Principle, as a distinct enti-

Digitized by Google

ty,—these vital motions are regarded as instinctive. "The law of instinct," says Dr Good, "is the law of the vital principle; instinctive actions are the actions of the living principle." By M. Virey also, these organic motions are regarded merely as a species of instinct; under which general term he includes, as well the mechanism of organization, as "those spontaneous outward impulses which, like the former, manifest themselves without the intervention of intelligence." We hope to make it appear, however, that the two are, in the main, as distinct from each other in their nature and conditions, as either of them is from reason.

It is then to simple irritation that we ascribe the chief kinds of vital action, whether obvious to the senses or inferred, in which the functions commonly called organic, such as the digestion of the aliment, the circulation of the fluids, secretion and absorption, consist,—functions carried on not only without the will, but without the consciousness of the being in which they are taking place.

Organic life is exemplified in its simplest form by plants, since, in them, the indications of any superadded functions, dependent on the possession of certain other faculties besides irritability, which most animals display, are in general somewhat ambiguous. Nor is it merely in the motions continually going on within themselves, by virtue of certain common stimuli, to which they are constantly exposed, that the irritability of plants consists, since many of them display very remarkable move-

Digitized by Google

ments when certain parts of their surface are exposed to the touch or to other mechanical agents. It is familiarly known to every body, that if the finger be applied, however slightly, to the leaves of the humble plant *(Mimosa pudica)*, they immediately acknowledge the impression and subside; and if a fly or other small insect alight on the leaf of the Venus fly trap *(Dionæa muscipula)*, it is often suddenly imprisoned, by the closing of the leaf over it in the manner of a cup. In like manner, the stamens of the common barbery *(Berberis vulgaris)*, of the prickly pear *(Cactus opuntia)*, a kind of nettle *(Urtica pilulifera)*, and of several other plants, are immediately stimulated to very remarkable motions by the application to them of various agents. These motions are the result of mere irritation, and similar to those which may be excited in the muscles of an apoplectic man—in whom the organic functions alone continue to be performed—by similar means. But by far the most wonderful examples of the irritation of plants, are the processes continually going on within themselves, from which result the assimilation of their aliment, the motion of their sap, and in particular, the periodical formation of their several parts, such as the leaves and flowers, the exquisite delicacy and beauty of the structure of which, and the direct subserviency of each part to the usefulness of the whole, infinitely surpass those of any production of either instinct or reason that ever existed; nay, some of the motions of plants bear the closest affi-

Digitized by Google

nity to the actual instincts of animals. But as it does not yet appear how far these are produced by any apparatus of sensation, such as exists in animals, it seems proper to take notice of them here under the head of irritability, rather than to place them under the same head with animal instinct. It is well known to every body, that if a plant be kept in a room which is lighted only by one small hole, it will always shoot towards that aperture, and having passed through it, will afterwards vegetate in its natural direction; and it is equally so that many plants, the hop-plant *(Humulus Lupulus)*, for example, revolving round a pole, and the gorgeous sun-flower *(Heliotropium annuum)*, rotating on its stem, follow the course of the sun. The experiment of Dr Percival also, in proof of the tendency of plants to move in search of pure air, has often been appealed to. "Several years ago," says he, "while engaged in a course of experiments to ascertain the influence of fixed air on vegetation, the following fact repeatedly occurred to me. A sprig of mint suspended by the root, with the head downwards, in the middle glass-vessel of Dr Nooth's machine, continued to thrive vigorously, without any other pabulum than what was supplied by the stream of mephitic gas to which it was exposed. In twenty-four hours the stem formed into a curve, the head became erect and gradually ascended towards the mouth of the vessel, thus producing, by successive efforts, a new and unusual configuration of its parts. Such exertions in the sprig of mint to

Digitized by Google

rectify its inverted position, and to remove from a foreign to its natural element, seems to evince volition to avoid what is evil, and to recover what had been experienced to be good." The same tendency also is constantly evinced by the plumula of the seeds of plants, which, in whatever direction the seed be sown, always rises into the air, while the radicle with equal constancy sinks deeper and deeper into the soil. In this case, while the former ascends in search of air, the latter descends in search of moisture; and the power which all roots display of altering their course whenever they approach a substance which would afford them insufficient nourishment, and of shooting towards any thing which promises them abundance of this, has been very frequently remarked. Lord Kames relates an instance in which a fine compost for flowers was left for two or three years at the foot of an elm, and, in this period, the greater part of the root of the tree had shot into it; and it has been proved by repeated experiments, that if a wet sponge be placed near a root, exposed to the air, the fibres of the root will extend towards it, and change their course as often as the situation of the sponge is changed. Now these motions of plants, unlike those of certain parts of the humble plant, the Venus' fly-trap, the prickly pear, and others to which we have already alluded, are not the result of any direct stimulus applied to them, but take place rather from the defect of such stimulus. The plant in comparative darkness moves in search of

Digitized by Google

light, the hop and the sun-flower, which the sun is deserting, move in search of heat, the sprig of mint in carbonic acid, and the plumula of seeds in earth, move in search of air, while the radicle of seeds and the roots of plants in general, in comparatively arid situations, move in search of moisture; and all these, light, heat, air, and moisture, are the ordinary and essential stimuli of plants, but they cannot act where they are not. These motions of plants, therefore, cannot arise from any *direct* irritation, but must proceed from something analogous to the sensation of a want, originating in an *indirect* irritation excited by the absence of their accustomed stimuli, and prompting them to the proper means of relieving it by motions quite analogous to those which in animals are called instinctive. They do not imply thought any more than the satisfying of hunger, by taking food implies thought; but do they not imply sensation in that modification of it which is called touch?

Nor is it only in pursuit of good, but also in warding off evil, that many plants appear to display a form of instinct. This is the case with the Convolvulus arvensis, the Anagallis arvensis, or poor man's weather-glass, and many others, which constantly fold up their petals in cold cloudy weather, or at the approach of rain, and do not again unfold them till cheered by the returning sun. These instances, however, are less conclusive in favour of the doctrine which ascribes instinct to plants, than those previously adduced; since it may be made a

Digitized by Google

question, whether the motions, in these cases, do not arise—like the reputed sleep of plants—rather from the intermission of ordinary actions, than from the supervention of new ones. Perhaps it is the expansion of the petals, when acted on by the stimulus of light and heat during fair weather, which should be considered as their active state, while the closure of them, when these are withdrawn, should be regarded as their repose; but in the instances previously adduced, there can be no ambiguity, and as motions similar to them, when displayed by animals, are without hesitation admitted as evidences of their instinct, they must be taken as proof of an analogous function in plants, and appear to be explicable in the manner above proposed.

What has been said of the irritation of plants may be applied equally to that of animals. It is upon this that depends the action, more or less constant, of the stomach and intestines, of the heart, and of all the other viscera which minister directly or indirectly to the several organic functions, as well as that—infinitely more wonderful—of the extremities of the bloodvessels, from which results as well the primary formation as the continued subsequent maintenance in a state of integrity of all the organs of the body. And what result of either Instinct or Rational actions,—what snail's shell, what spider's web, what bee's comb, what bird's nest, what beaver's hut on the one hand, or, on the other, what piece of workmanship that ever issued from the

Digitized by Google

hand of man, gifted with the highest degree of intelligence, profound in every department of science, and skilful in every branch of art, can for a moment compete, in delicacy and beauty of structure, or in subserviency of means to the end in view, with the eye or ear of the humblest reptile that crawls? How admirably, likewise, is each organ of every animal adapted, not only to the function in general, to which it ministers, but to the particular modification of that very function, as connected with the habits of the individual; or rather, assuming what appears to be really the case, that the habits of animals are dependent on their organization, how perfect is the harmony of structure between all the organs of every animal, as conducing equally to certain habits! Where do we find the rigid spine, the hinge-like wrist, and the few and hoof-clad toes, which characterise a vegetable feeder, associated with the broad jaw-bone, with its hinge-like joint and powerful elevating muscles, and the sharp-pointed teeth, or with the simple and short stomach and intestines which distinguish a carnivorous quadruped; or where, on the other hand, the flexible spine, the rotating wrist, and the numerous well-armed toes, adapted for seizing and retaining living prey, associated with the long and narrow jaw-bone, with its revolving joint and strong lateral muscles, and the broad flat teeth, calculated for grinding grass, or with the numerous stomachs and long and complicated intestinal canal, appropriated to its digestion? "The reason," says Kant, "of the ex-

Digitized by Google

istence," and he might have added of the character, "of each part of an organized being resides in the whole;" and how admirably is the correspondence, in this respect, of all the parts of every tribe of animals, can be only conceived even by one who has within his grasp, as it were, the whole of animated nature, and is master in detail, of the anatomy and physiology of every individual which it embraces. Where shall we look, among the results of either Reason or Instinct, for productions at once so exquisite, considered individually, and so harmonious, when contemplated as parts of a stupendous whole, as these results of simple irritation?

It has been presumed by some authors, who seem, like Good and Virey, to have confounded the actions just described with those properly called instinctive, that the latter are merely the operations of a kind of machinery obeying certain fixed laws, like those of attraction and repulsion, of which each of the inferior animals, presuming that they are actuated by instinct alone, is an example; and, consequently, that the various structures, such as the shell of the snail, the web of the spider, and so forth, which result from such operations, are only one remove, with respect to their manner of formation, from the arrangement of matter constituting the hoar-frost which forms on the window in a winter night, or a salt which crystallizes from its solution. This doctrine appears to have originated with Pereira in 1554, and was subsequently adopted by Descartes, Buffon, and many others. In all

Digitized by Google

probability, however, it is not so much to really instinctive actions as to those which we have just described as proceeding from irritation that it is applicable. And, indeed, in as far as the internal administration of their bodies is concerned, not only the lower tribes of animals, but man also, seems to be little better than a machine, acting in blind obedience to laws, vital indeed, and so far superior to those which regulate the condensation of a vapour, or the crystallization of a salt, but still entirely independent, as respects the major part of them, as well of the consciousness, as of the volition of the individual in which they manifest themselves. The actions, then, resulting from these laws may be regarded perhaps as something intermediate, as it were, between those which take place in the mineral kingdom and those properly called instinctive.

Before proceeding further, however, the view just alluded to, which confounds organic acts with true instinctive acts, merits a brief consideration. This view, perhaps, dates from the vegetative soul of Plato, and runs more or less throughout many systems both ancient and modern,—the constructing soul of Aristotle, the impetum faciens of Hippocrates, the archæus of Paracelsus and Van Helmont, and the formative appetency and propensity of more recent ones,—for there is this common to all these varied views and expressions, that something like intelligence or consciousness of design is implied as existing in the principle made to direct and preside over organic acts. And the prevalence

Digitized by Google

of this mode of explaining such acts through so many ages may be ascribed to that early propensity among men to satisfy their passion for giving causes to events and the like, to call in the agency of animate beings in the shape of a goddess, nymph, or genius loci, as often as they fail to hit upon a more intelligible cause. But let us consider how far there are any points of resemblance between organic and instinctive acts, in order to draw the proper line of distinction between them. Organic acts are not all of the same kind; one description is analogous in effect to the operations of chemistry, while another bears an analogy to mechanical results. Thus, the conversion of aliment into chyme in the stomach, the separation by the lacteal tubes of the chyle from the mixture of chyme, bile, and pancreatic juice contained in the intestinal canal; the conversion of the chyle into the blood; the purification of the blood in the lungs under the influence of the atmospheric air; the formation of the several constituents of the secretions; the deposition of new matter for the growth and repair of the solids; and, finally, the removal of decayed or exhausted tissues, are so many operations strictly analogous to the ordinary effects of chemistry, though not produced in accordance with the known laws which regulate the chemistry of inert bodies. These processes, indeed, constitute organic chemistry, and the bodies concerned are, as in every other kind of chemistry, minute particles acting on each other at insensible distances, by attraction and repulsion, the particles

Digitized by Google

here being not mere atoms, but organic particles or molecules. These organic molecules, by the attractions and repulsions, and the capabilities of change under the variation of conditions and circumstances to which they are subjected, are instrumental in the growth and development, the repair and maintenance, and, finally, in the decay and death, of animal bodies. Here, then, are thousands and tens of thousands of organic molecules unceasingly ranging themselves each in its appropriate place, changing that place to assume a new situation, and altering their very nature to fit themselves for new circumstances; so that the collective effect of the acts and changes of each is the production and support of a machine unequalled in the intricacy of its parts, unparalleled in the complexity of its movements. What may be called a poetical solution of these phenomena is, to conceive each of these numerous particles endowed with intelligence and consciousness, and capacity of action sufficient to enable it to perform its particular task, so that the united operation of the whole multitude may give effect to the production and maintenance of an animal body. This, however, becomes a highly rational view when changed to this form: it has pleased the Almighty Author of Nature to impress, or to cause to be impressed, on such molecules certain capacities of action to be called forth variously under different circumstances of position, imparted and withdrawn under definite conditions, so that their blind and unconscious action on each

Digitized by Google

other has for its result the animal frame, a work of the most perfect design,—the chief wonder of creation.

The analogy between the operation of such molecules and what are generally known as the operations of instinct, cannot but be discovered on the most superficial glance. Nor would it be illogical, however little it may be expedient, to term the attractions of such molecules instinctive affinities.

While, then, there is an undeniable analogy between the acts commonly regarded as instinctive, and those processes of the living machine, there is also a broad line of distinction, the former being exclusively acts of relation or animal acts, and, at the same time, of a mechanical nature, or analogous to mechanical movement, while the latter are assimilative actions, and analogous to chemical operations.

The acts, however, of a mechanical kind belonging to the functions of assimilation make a nearer approach to ordinary instinctive acts, and are, indeed, often ranked under instinct; for example, the contraction of the heart in the circulation of the blood, the enlargement of the chest in respiration, the evacuation of the stomach in vomiting, and the expulsion of the contents of the bladder and rectum. These acts, in as far as they are independent of the will, are termed automatic; and, while most of them become so far subject to the will, they are all at birth involuntary, the influence of the will over them being altogether acquired. With the exception of the heart's contraction, concerning the

Digitized by Google

exact nature of which physiologists are not yet agreed, all the above acts are dependent upon sensation; from which it will afterwards appear that all ordinary instinctive operations result. And it will perhaps facilitate the exposition of the connection between sensation and instinct, to consider such acts along with instinctive acts, as less equivocally under the influence of that principle.

Digitized by Google

CHAPTER VI.

SEAT OF IRRITABILITY.

With respect to the immediate seat of irritability, which we have just treated of as an attribute of organized beings, there is reason to believe that, like all analogous faculties, it is situated, in animals, in some part of the nervous system; and as we know that the faculties and powers imparted respectively by the spinal chord and brain, situated within the vertebral canal and skull of such animals as are furnished with a skeleton, are quite distinct from irritability, and that this faculty continues unimpaired when the influence of both these portions of the nervous system is suspended, we should be disposed, *a priori*, to refer irritability to the ganglionic, as the only remaining portion of the system in question. This system, as has already been shewn, consists essentially of two sets of knots of nervous matter, situated one on each side of the body, on a line principally with the spine,—in animals furnished with one,—but before it, and connected together by slender chords and net-works, which further extend from them in all directions. In animals without skeletons, it is, of course, amalgamated, as

Digitized by Google

it were, with the spinal and cerebral systems. Now, according to Sir Charles Bell, "we know only what the sympathetic nerve"—the main branch of the ganglionic system—"is *not;* and by that means are left to conjecture what *are* its functions." But besides this negative evidence in favour of the theory that it is the immediate seat of irritability, some positive facts may be adduced in its support. And in the first place, it may be alleged that as the display of sensibility and of thought by every tribe of animals as we rise in the scale of creation, is severally coeval with the appearance of a spinal chord and a brain—the acknowledged seat of these faculties—so the first indication of irritability is coeval, in general, with that of a ganglionic system of nerves, which, of course, therefore, is the first met with in the ascending scale of animals. The ganglionic system of nerves, moreover, as ministering apparently to an essential condition of any degree of development, is rarely or never found wanting, however monstrous the infant may be; whereas sensibility and the faculty of thinking being, as it were, adventitious properties, the spinal chord has not unfrequently, and the brain very often, been found defective. Further, this system of nerves is, in general, relatively larger in children and females, than in adults and males, and it is commonly very small in old persons; and it is well known how much the irritability of old persons commonly falls short of that of middle-aged persons and males, and the irritability of these again, that of children and females. Finally, the internal structure of the ganglions, and of the nerves connected with them, is very similar to that of the sensific system in general; and as we know that the former do not impart sensibility, it is only fair to believe that they impart an analogous faculty; and what is so analogous as irritability? It is remarkable also, that, wherever the irritability of two or more organs of the body seems to be of a different character, a corresponding difference has been observed in the particular structure of the ganglionic nerves which supply them. It may be objected to this doctrine respecting the immediate seat of irritability, first, that plants, although they possess irritability, have no nerves whatever; secondly, that the ganglia which send nerves to any particular organ, may be removed without depriving this organ of its irritability; and, thirdly, that the distribution of this system of nerves is too circumscribed, to allow of our attributing to it a faculty possessed by every part of the body.

To the first objection, however, it may be replied, that supposed traces of a nervous system *have* been detected in plants, and, what is remarkable, chiefly in those which afford the most striking instances of irritability; and even though no such traces had been found, it would be as unreasonable to deny that the ganglionic system of nerves is the immediate seat of irritability in animals, because plants have no such system, as it would be to deny that the stomach and heart are, in most animals, the chief agents in effecting digestion and the motions

Digitized by Google

of the fluids, because plants perform these functions without their aid. To the second objection it may be answered, that, when we remove a ganglion, we do not immediately impede the functions of the nerves connected with it, each point of such nerves —which, in this respect, are unlike the spinal nerves—being a source of nervous energy to itself, and quite independent, for a time, on any common centre. Lastly, against the third objection it may be said, that such is the communication between the spinal and ganglionic nerves in numerous parts of the body, that we seem to be justified in believing that whithersoever a nerve from the former system proceeds, thither a filament from the latter accompanies it, and, consequently, that the distribution of the ganglionic nerves, however apparently circumscribed, is in fact universal. Upon the whole, we are disposed to think favourably of the theory in question; and we have dwelt upon it, perhaps, at somewhat greater length than the subject may seem to have demanded, from our desire to assign "a local habitation" to the faculty of irritability, as well as to those of which we are presently to speak, and thus to establish, not only the differences in the condition of functions which we have presumed to be different, but also, as far as possible, the source of these differences, as connected with the organization of the body.

We shall conclude these arguments by briefly drawing upon the lucid account of the history of

Digitized by Google

the ganglionic nerves, as given by our lamented friend Dr Fletcher.*

Before the time of Galen, the ganglionic system of nerves was entirely unknown, and although by him and his followers, the Arabians, the existence of this system, as well as its supposed origin, was pointed out, it was not till the time of Willis that the ganglionic nerves were generally considered as a part of the nervous system at all. Willis, however, still looked upon them as merely an appendage to the cerebro-spinal system, and represented them, both in his verbal description of them, and in his curious diagrams of their distribution, as growing upon the latter "ut frutex super alio frutice;" and this notion having been adopted by numerous other writers, both before and since the time that their independence was insisted on by Winslow, it has become a prevalent custom to regard these nerves as of very secondary importance, and the names imposed upon the system in general, as well as the uses assigned to it, have generally corresponded with this idea. But it were needless, in this place, to follow our author through all the untenable opinions that have been entertained concerning these nerves. Even in the present day, the functions of this system is matter of dispute; Mr Mayo follows Dr Bostock and others in saying "it is unknown" (*Outlines of Physiology*, 1833); and Dr Henry, in his report to the British Association of the same year, observes, that it "is mat-

* Rudiments of Physiology, part ii. *a*, p. 64, note *a*.

Digitized by Google

ter, at present, of conjecture." This, however, we hope we have persuaded the reader, is far from being the case; and it is probable, from the circumstance of the ganglionic system of nerves not having been generally introduced to the notice of physiologists, till their minds were fully made up respecting the cerebro-spinal system as the only primary source of nervous energy, as it is called, that the real independence of the former has been overlooked, and facts warped in support of prejudice and habit. Perhaps Winslow was the first to describe the ganglions of the sympathetic system as a kind of nuclei, or little brains, generating a peculiar property or power of their own,—a description which was adopted by Le Cat; but it is from the celebrated Essay of Johnstone (*On the Use of the Ganglions*, 1771), that the origin of the opinion that they are the primary source of irritability may be dated. The notion of the independence of the ganglionic system was espoused by Cuvier, and particularly insisted on, with his accustomed eloquence, by Bichât, who represented all the ganglions of this system as "des centres particuliers de la vie organique, analogues au grand et unique centre de la vie animale, qui est le cerveau;" and who further demonstrated, not only that all these ganglions were collectively independent of the cerebro-spinal system, but that each ganglion was independent of every other—nay, that each nerve proceeding from such a ganglion was in a great measure independent of that ganglion, and that even each

Digitized by Google

point of such a nerve was independent of all the rest, and constituted alone a distinct focus of nervous influence. The doctrine which ascribes irritability to the ganglionic system was, however, still more explicitly promulgated by Peffinger, Reil, Richerand, Gall, Wutzer, and Broussais; the last in particular describing the ganglionic system of nerves as possessing a peculiar kind of sensibility, (i. e. irritability) with which it immediately endows all the organs destined for deposition, absorption, and the other organic functions, and, by means of its repeated connexions with the cerebro-spinal system, all the organs of the body. Views, such we would inculcate as to the seat of irritability are certainly increasing in popularity; and the reader who wishes to pursue the subject further, will find it forcibly advocated in the works of Dr Copland, Mr Parker, Dr Lovell, Phillips, and especially of Dr Fletcher.

Digitized by Google

CHAPTER VII.

OF SENSATION AS A CAUSE OF MOTION IN ANIMALS.

Myriads of animals exist in all parts of creation; but especially in water, enjoying a brief, but, we cannot doubt, a pleasurable life. Many of these are so minute that it is scarcely possible to conceive, even from their effects, the nature or the range of the powers which they exercise; and simply constructed as these creatures are, they nevertheless display a sensibility of astonishing acuteness;—the faintest impression, which in the more highly endowed animals passes unfelt or unheeded, such as a beam of light or the agitation of the air or water, exciting in them motions shewing that they are conscious of and stimulated by these external agents. Some polypi appear to derive gratification from the influence of light, seek its présence and are observed to move towards it, while others display as decided an aversion to it, retreating before the slightest glimpse. Sensibility, or the susceptibility of sensation, then is co-existent or nearly co-existent with the animal kingdom; in the lower range of which, however, it must be but the rudiment of what it is in the higher. The term implies the

Digitized by Google

power of transmitting the effect of a stimulus applied at one part to a more or less distant part or organ; and while certain preliminary physical changes must be presumed to occur in the nervous substance, a consciousness of a new impression is the final conclusion of a sensation. It has been long observed, that certain sensations are so invariably followed by certain muscular acts, that they are properly regarded in physiology as the direct consequences or effects of them. These are best known in the organic acts before referred to as being analogous in their effects to mechanical operations—most of these were originally involuntary, but have become, at least in man, subject to the will. They have a very close resemblance to instinctive acts, and indeed are often said to be so; although in as far as they take place without the control of the will, they are better termed automatic acts dependent on sensation. The difference, however, between them and instinctive acts is somewhat arbitrary, being nothing more than that they are subservient to organic life, or the assimilative functions; while true instinctive acts almost exclusively belong, as has been before remarked, to the functions of animal life, or those of relation. If it appear, then, that many complex muscular acts are the direct effects of sensation, there will be less difficulty in the admission of the conclusion at which we shall hereafter arrive, that instinctive acts in general are the result of definite sensations. Thus inspiration depends on the sensation which arises

Digitized by Google

when the venous blood in the capillaries of the lungs affects the sentient extremities of the pneumo-gastric nerve. The stimulus is propagated upwards to the encephalon; and, as it is to be presumed, a physical change in some part of that organ is the consequence, which, in certain states at least of the animal, is accompanied by a perception of uneasiness, referred to the chest, and more or less distinct, according, to the degree in which the original cause, namely the presence of venous blood in the vascular tissue of the lungs, is applied. This sensation, then, as often as it takes place, according to an original law of the animal economy, at least in certain orders of animals, is succeeded by a transmission of nervous power originating in the nervous centre,—but by what means we know not,—along the nerves of the diaphragm and intercostal muscles, which under this stimulus contract and enlarge the chest for the admission of air. It has been determined that the only part of the encephalon essential to this sensation is the medulla oblongata; and accordingly anencephalous monsters or those born without brains, live and breathe for a short time after birth, if the spinal chord rises within the skull, without which portion of the encephalon they perish instantly, because when it is wanting the lungs do not act. Death by "pithing" gives an additional illustration of the same thing, for death in that case is produced by the destruction of that part of the nervous system on which the sensation essential to respiration is dependent.

Digitized by Google

It can no longer be reasonably doubted, but that what is here stated, namely, that respiration is directly the consequence of the occurrence of such a sensation, is an observed fact; but it may be asked, does this fact afford any explanation of the nature of the connection between the two acts? It does not further than to this extent, that, in the animal economy, before the influence of the will is established, and after that, as often as the will is suspended, as in sleep, these two acts stand to each other in the relation of cause and effect—that is, of invariable antecedent and consequent; or, that the explanation is as perfect in kind as the nature of human knowledge admits of. And supposing it were a settled point, that no intervening link in the chain of causes could possibly be attained by the human mind, it might then be safely pronounced as full an explanation as the effect of impulse in generating motion,—since no other reason can be ultimately assigned for the latter than for the former, but that such is the will of the Almighty,—that being the final link in every argument upon causation in general. Although, then, it is possible that some intervening event may hereafter be discovered between the occurrence of sensation and such automatic acts as we have described, it must, in the mean time, be regarded, in this as well as in all similar instances, as a logical and sufficient cause.

Not merely, however, does the simple act of respiration admit of explanation on this principle, but all, or nearly all, the varieties and modifications of

Digitized by Google

which its apparatus is susceptible, may in like manner be referred to particular forms of sensation. Thus, the first respiration after birth is not correctly ascribed to a sensation originating in the capillary vessels of the lungs, because, till the air of the atmosphere has entered these organs, the kind and quantity of blood contained in them must be nearly the same as it was just before birth, so that no cause of a new sensation is derived from this source by the mere circumstance of birth. But in this case there is another and a very important source of sensation in the contact of the very vascular surface of the infant's body with the external atmosphere; that is, the contact of a membrane in the highest degree provided with nerves and bloodvessels, and which has up to that period been accustomed to no greater stimulus than that of a bland fluid, uniform in its composition, uniform in its temperature, and uniform in the mode of its application, with a penetrating aëriform fluid abounding in oxygen, the most powerful agent, perhaps, which acts upon the blood, and of a considerably lower temperature than that to which the infant's feelings have hitherto been habituated. The joint stimulus, then, of the cold and of the oxygen of the atmosphere cannot but be productive of a vivid sensation, and this sensation is admitted generally by physiologists to be the immediate cause of the first inspiration: that is, the sensation is by an original law of the animal constitution followed by a transmission of motor power to the muscles by which the capacity of the thorax

Digitized by Google

is augmented. Of the very numerous attempts to expound the cause of the first inspiration after birth, such is that which is least open to objection, and which has accordingly obtained the sanction of the most eminent physiologists of our times. The fact before referred to, that infants born altogether without an encephalon cannot breathe, while those which have no more than the medulla oblongata within the skull do so for a short time, is in perfect accordance with this view, and in a great degree confirmatory of its truth.

Nor is this by any means the only instance in which the application of stimuli to the surface of the body is attended with an effort of respiration. The effect of going into the cold-bath when we are unaccustomed to it, or when the water is unusually cold, is familiar to every one. There is in this case a succession of almost convulsive inspirations, which admit of no explanation so simple, as that they are dependent on the sensation which originates in the cold applied to the surface. This, in short, is very much the same as what happens to the infant at birth; for having been accustomed, during all the previous part of its existence, to a temperature equal to that of the internal parts of the mother's body, it is suddenly plunged into a new medium of a more stimulating kind, and at the same time lower in temperature.

Again, it is observed, that respiration goes on with much greater energy in cold air than in warm, a familiar example of which is the facility with which

Digitized by Google

persons in health keep up the natural temperature, or even overheat themselves by moderate muscular exertion in frosty weather. Now, although this effect is attributable to the joint operations of several causes, yet one of these the least equivocally called into operation, is the sensation which follows the application of cold air to the surface.

The effect of sprinkling cold water on the face, or on other sensible parts of the surface of the body, in promoting the recovery from a fainting fit, is a fact with which every tyro is acquainted. This effect is, however, the result of the same principle, namely, of the increased activity of the muscles of inspiration, consequent on a sensation of cold derived from the surface. It might be allowable to avail ourselves of this, as a fact bearing on the view which ascribes motion to sensation, after a simple reference to the circumstance familiar to every one accustomed to see persons affected with fainting, of the return of animation being accompanied by a full inspiration; but at the risk of being somewhat tedious, it may be proper to exhibit to the non-medical reader, how well the whole theory of the recovery from this state accords with the doctrine which we would advocate. Fainting consists in a cessation or very great diminution of the action of the heart. Consciousness ceases, for it is observed that the functions of the brain are performed perfectly only when the blood moves through the cerebral vessels with a certain degree of momentum; yet it does not follow that the sensibility of all the

Digitized by Google

parts of the nervous centre is altogether suspended. Thus in many instances, where consciousness is lost, together with all exercise of the external senses, and of the power of volition over the muscles of voluntary motion, so that the sufferer helplessly falls to the ground, enough of sensibility remains to carry on the function of respiration, dependent though it be on sensation; that is, at least, on the physical steps preliminary to a perfect sensation. Such is the case in the comatose state which follows severe injuries of the brain, which attends apoplexy, and the epileptic paroxysm, and the unconscious condition which often precedes death; in all which instances the medulla oblongata retains its property of being so affected by the venous blood acting on the extremities of the nerve of the lungs, as to generate the motor power necessary for the muscular act of inspiration, after the other parts of the encephalon exhibit no visible signs of being susceptible of the ordinary effects of their proper stimuli. In fainting, however, this part of the nervous centre has its sensibility very much impaired, though not altogether destroyed; while partly from this cause, partly from the languid and interrupted motion of the venous blood from the right side of the heart towards the lungs, the respiration, if not wholly suspended, becomes imperceptible. The person is placed in the horizontal position by which the resistance to the return of the venous blood from the extremities to the right side of the heart is diminished, so that, determined by the

Digitized by Google

slight movements of the heart still subsisting, or perhaps only by the contraction of the arteries, it gradually accumulates in the chambers of the organ on the right side, in sufficient quantity to stimulate them to contract and transmit it to the lungs. One step, then, towards recovery has now been made, in the application of the proper stimulus on which inspiration depends, to the extremities of the pulmonic nerve; and even if the sensibility of the medulla oblongata and other sentient parts at the base of the brain had been wholly lost at first, as the horizontal posture of the body assists the motion of the blood in the veins of the lower extremities and abdomen towards the right side of the heart, so must it promote the languid motion of the blood in the arteries, whether kept up by a slight action of the organ, or only by the slow contraction of the arteries towards the base of the encephalon, by which its sensibility must be in part restored. If, then, an inspiration is determined by these causes, the venous blood both flows more freely towards the chest, and therefore towards the right side of the heart by the action of the thorax during that act, and the blood flows with greater facility through the lungs towards the chambers of the left heart by which its action is increased or restored. If, in the mean time, cold be applied to the face, which is copiously supplied with nerves of sensation derived from the base of the encephalon, the inspirations become more energetic, and thus the entire recovery of the person is accelerated.

Digitized by Google

It would be tedious to multiply instances of the influence of the sensation resulting from the application of cold to the surface, upon the mechanical act of inspiration; with one or two other instances, then, we will content ourselves. When the concentrated hydrocyanic or prussic acid is administered to an animal, all signs of life almost immediately cease—yet this is not death; for the animal may be often recovered by the artificial inflation of the lungs. The state produced by this agent seems to be a suspension of the function of the nervous system; the immediate consequence of which is an interruption of respiration, inasmuch as it is a function dependent on sensation. If, then, respiration be kept up artificially for some time, the effects of the poison on the nervous system by degrees decline, natural respiration is restored, and the animal, which would otherwise have perished, is revived. It has been observed, however, that dashing cold water on the surface proves, in such a case, a substitute for artificial respiration, so as to furnish another evidence of the influence of the sensation of cold upon respiratory movements. It is stated in the earlier reports of the effects produced on dogs in the Grotto del Cane near Naples, that they were immediately recovered by being plunged into cold water. The effect produced by the carbonic acid of the cavern is much the same as that of the hydrocyanic acid; and it is by no means improbable that this old practice, which is now neglected, would save the dogs much of the suffering which they are de-

Digitized by Google

scribed as undergoing in recovery, by those who have more recently visited this famous place.

In illustration of the power of definite sensations in modifying the action of the muscular apparatus of respiration, expectoration and sneezing afford an instructive evidence. The design of both acts is to expel noxious matters which may have gained access to the windpipe or nostrils. When any unusual irritation affects the nerves of the membrane lining the air-passages, cough with expectoration is produced. Thus in deglutition, if any particle of food enters the larynx, it is instantly expelled by a violent effort of the respiratory organs; and when the secretion of the membrane itself becomes either over abundant or acrimonious, or morbid matter is determined from diseased parts of the lungs, or even from the adjacent organs, expulsion in the same manner occurs. We have here, then, an unusual stimulus applied to the extremities of the nerves in this membrane, which becomes the source of a sensation destined to be followed by the transmission of motor power to a certain combination, and that a complex combination of many muscles. Cough and expectoration take place in the following manner. A full inspiration is produced by the rapid action of the muscles, by which, in ordinary circumstances, the chest is enlarged. This of itself implies the operation of the motor power in an unusual manner through several distinct nerves; then the aperture of the larynx is firmly closed by the action of appropriate

Digitized by Google

muscles; next the muscles of expiration come into rapid, even convulsive, or at least unusual action, while the air, much condensed, is retained by the closure of the larynx till that organ relaxes, when rushing forth with great impetus, it sweeps along the substance giving rise to irritation, and which is said to be expectorated or spit up. The effort is repeated to an extent proportionate to the quantity of the irritating matter, and the difficulty of its removal. Cough takes place under too great a variety of circumstances of a morbid kind to be fully explained in a treatise of this kind, which seeks an illustration only from the general principle of the act, without pretending to enter into any of the pathological details connected with it. It may, however, be satisfactory to the uninitiated reader, briefly to give a reason why cough sometimes arises, when there is nothing to be expectorated. In pleurisy an example of this kind is usually met with. There, on account of inflammation affecting a neighbouring membrane, the pleura, by means of what is called in technical language a derivation, the ordinary secretion with which the membrane of the air passages is bedewed and defended from slight irritations becomes deficient, and the atmospheric air itself, the continual entrance of which is a necessary condition of the function of respiration, now constitutes a source of irritation: or cough is excited, not by the presence of any uncommon irritation, but by the unusual susceptibility of the

Digitized by Google

nerves to be affected, when deprived of an ordinary means of protection.

Sneezing even more signally illustrates the doctrine which it is the object of all these details to support. An irritation affects the membranes of the nostrils, and is succeeded by an act of inspiration and another of expiration, in which the expulsion of the air takes place through the nostrils, carrying with it all the irritating substance; and both these acts are altogether peculiar in their character, being very different from the same acts under any other circumstances. Nor can this peculiarity and difference depend on any other cause, than the peculiarity in the modes in which, and the combination of the muscles to which, the motor power is conveyed. And this peculiarity in turn admits of no other explanation than that of an established connection between the sensations originating in irritation applied to the nostril and the generation of such a motor power. The chief peculiarity in the action of the respiratory apparatus in sneezing, consists in both inspiration and expiration taking place while the mouth is closed, and also the passage between it and the nostrils; and further, the inspiration being a slow convulsive movement, while the expiration is as much distinguished for its force and rapidity. It may be worth while to mention, that sneezing is prevented even after the preliminary steps have commenced, by any thing which engages the attention; thus we often may prevent a person who is made to sneeze easily by snuff doing so, by

Digitized by Google

telling him that it will not cause him to sneeze. The very wish to sneeze, or the doubt raised in his mind by the confidence of the assertion, prevents the sensation being followed by its effects. Sighing and yawning are two other forms of respiration, the peculiarities of which must be ascribed to a modification of the ordinary cause of respiration, namely, the stimulus of venous blood in the capillaries of the lungs. Both these acts arise, when the circulation through the lungs is in a languid state, and both consist of an inspiration and expiration, each of a specific kind; and though the word sigh, in all languages, appears to point to the expiration, while the word yawn points to the inspiration, yet they are so closely allied, that when the approach of either is foreseen, it may usually, by an effort of volition, be exchanged for the other. Depressing affections of the mind, want of sleep or of mental occupation, and hunger, are the ordinary conditions on which both occur. It is not so easy to point out the particular circumstances which determine sometimes the one and sometimes the other, to occur under what appears to be nearly the same state of the system; nor is it necessary for our present purpose to enter into any scrutiny of such a nicety; let it suffice to refer to what every one must be aware of, that the sigh more particularly attends depressing affections, while the yawn is chiefly the result of fatigue, idleness, listlessness, and hunger. It may readily be proved, then, that under these circumstances, both the circulation in the lungs and

Digitized by Google

the state of the encephalon, have deviated from a perfect state of integrity or health. A languid state of the former and an impaired sensibility of the latter, must mutually act and react upon each other, until a new state of relation between the one as an excitant and the other as a recipient of stimulus, is established. Whatever retards the motion of the blood through the lungs, by impairing the activity of the heart's action, on a principle before referred to, diminishes the sensibility of the encephalon; and whatever has this effect in turn interferes with the due energy of respiration. It must be supposed, then, that as both the effects go on accumulating under the circumstances supposed now to exist, the venous blood collects in the capillaries of the lungs, owing to the defect of the mere mechanical act of the enlargement of the chest, in a greater ratio than that in which the sensibility of the medulla oblongata is repaired, so that the condition on which sighing and yawning arise, may be regarded as an unusual amount of the ordinary stimulus, viz. venous blood acting through the pulmonic nerves on a diminished sensibility of the part of the nervous centre on which respiration depends; and this variation in the relative states of the agent and the subject, is attended with a corresponding variation and effect; that is, a sigh or a yawn, as compared with an ordinary respiration.

In a sigh, however, hardly any muscles but those concerned in an ordinary full respiration are concerned; its peculiarity consists in a certain time

Digitized by Google

or rythm of action, a slow and measured expansion of the chest, and a corresponding compression of it.

In a yawn, on the contrary, many muscles not employed in ordinary respiration are brought into play, more particularly when the cause being greater than usual, it is attended with a stretching of the arms and legs or pandiculation; which, though it may be controlled by the will, is by no means a voluntary act. It must be regarded, then, as essentially determined by the same sensation as the simple sigh, stronger only in degree. We see, then, how many muscles this modification of the ordinary sensation on which respiration depends, brings into activity besides those concerned in the simple act; namely, the muscles which, by drawing down the jaw, open the mouth wide, the muscles which extend the several joints of the upper extremities, those which extend and straighten the trunk, and, finally, the numerous muscles which extend the joints of the inferior extremities.

The complex act of deglutition affords an illustration of the same kind of movement as the states of respiration just detailed. It may be conveniently divided into three stages. In the first, the mass collected on the tongue, after mastication and mixture with the saliva, is transmitted to the base of that organ; in the second, it is precipitated into the pharynx; and, in the third, it is transmitted through the gullet into the stomach. The first stage is very much under the control of the will

Digitized by Google

in adults, though doubtless originally automatic and determined by the sensation resulting from the mere presence of the mass in the mouth; of this stage no more need be said, than that the mass is pressed backwards by the motion of the tongue, while the muscles of the palate prevent it from being thrown upwards, and the mouth is contracted by the action of the muscles of the cheeks. No sooner, however, has the mass reached the base of the tongue, than a complex series of acts commences altogether beyond the control of the will, and determined by no other cause than the sensation which arises from the effect of a foreign body in that part of the throat. The hyoid bone is drawn forcibly upwards, and along with it the larynx is raised (as may be felt by putting the finger on the *pomum Adami*), while the epiglottis is forced down to close the aperture of the windpipe; the pharynx is also drawn upwards and forwards towards the base of the tongue. No sooner have the parts of the throat come into this state, than a sudden revulsion is occasioned by the action of antagonising muscles, during which the mass of food is precipitated into the œsophagus or gullet, and the parts restored to their former condition. While, then, we regard the stimulus of the foreign matter on the nerves at the upper part of the throat as the source of sensation, which brings into action the first series of muscles—not a few in number; the sensation which results from their contraction must be considered as the immediate cause of the contraction of the antagonising muscles, by which the sudden revulsion is produced. The last part of the act of deglutition, or the transmission of the bolus through the gullet into the stomach, is the most simple of all, and takes place, perhaps, without any sensation, merely by the stimulus of the mass on the irritability of the muscular fibres, which enter into the structure of the tube.

Vomiting is another act dependent upon sensation, the origin of which is not so simple as in the former cases, since it takes place under a variety of circumstances, such as the introduction of certain substances into the stomach, tickling the throat with a feather, injecting an emetic solution into a vein, and many others; still it will not take place under the operation of any such cause, if the encephalon be in a state of lesion or of deep stupor, and accordingly Magendie found that vomiting is immediately put a stop to by compressing the medulla oblongata. Whether, then, it be the medulla oblongata alone, or whatever other part of the nervous centre may be the immediate seat of the physical part of this sensation, it is allowed in physiology that such is the cause of vomiting. But vomiting consists not of a mere contraction of the stomach, nay, in perfect vomiting the stomach itself is passive, while a multitude of muscular organs are called into activity; and how should these be brought into motion? No other answer can be given but one similar to that offered in the former case,

Digitized by Google

namely, that it is an established law in the economy of animals, that as often as a certain sensation originating in a peculiar stimulus arises, it is succeeded by the transmission of a nervous power through motor nerves to a definite number of muscular organs, which are in consequence called into action, and produce the evacuation of the stomach. This automatic act deserves particular attention, as illustrative of proper instinctive operations, on account of the number of separate muscles called into action; its complexity is so great, that it does not, like many others, bend to the will even in man. Perfect vomiting is produced in the following manner:—The diaphragm, or midriff, which is in contact with the upper surface of the stomach, by the powerful contraction of its muscular fibres under the influence of the phrenic nerve, descends and remains for a moment fixed in this position, while the muscles which shut the aperture of the windpipe and those of the abdomen, act with a simultaneous and convulsive effort; so that the air being retained in the lungs, the ordinary effect of the action of the abdominal muscles, namely, the expulsion of the air from the lungs by the diminution of the chest, is prevented, and the whole force of these powerful instruments is made to bear on the stomach, still pressed on from above by the diaphragm, and thus that organ is evacuated instead of the lungs. Hence the motor influence transmitted from the nervous centre, as a consequence of the previous sensation, is not confined to the

Digitized by Google

phrenic nerve, but equally affects the nerves of the laryngeal muscles, of those of the abdominal muscles, and those which act simultaneously with the latter.

The evacuation of the bowels and bladder takes place in infants and undomesticated animals on a plan altogether similar. A local irritation affects the sentient extremities of their nerves; a sensation follows, which is succeeded by a transmission of motor power to the diaphragm and abdominal muscles, which contracting expel the contents of the organs. In infants the former operation is effected altogether independently of volition, though not without consciousness, which must exist both from the irritation produced on the nerves of the bowel by the distension of its cavity, and also from the contraction of the several muscles, as those of the abdomen and diaphragm, by which the organ is compressed, and the resistance of its sphincter overcome. But no one will deny but that if any unusual impediment occur to the evacuation of the rectum, the infant will suffer pain and become acutely sensible of the presence of an irritation, in the degree in which its intensity increases; or, which is the same thing, in proportion to the vividness of the sensation. What room, then, is left for denying that this act is dependent upon a sensation? Yet in it we discover the simultaneous action of many muscles, not only of the diaphragm and of the ordinary muscles of expiration, as those of the abdomen and

Digitized by Google

loins, but also of the pelvic muscles, and more particularly of one of them, the levator ani. The progress of this operation as the child increases in age, from a pure automatic to a voluntary act, gives an additional illustration of the dependence of such muscular combinations upon sensation. The nurse soon discovers when this act is about to take place; and by what signs? surely by no other than such as indicate that her charge is conscious of the first approaches of sensation, which, as it grows in intensity, will quickly enforce the action over which it presides. To trace the steps by which it becomes a voluntary act does not belong to our present purpose; but it can easily be conceived that, within certain limits, an act which is accomplished from the first by muscles destined to be under the control of the will, may be suspended for a time by antagonising muscles, equally under the dominion of the same power.

What has been said of the evacuation of the rectum applies very closely to that of the bladder. There is a similar irritation of the nerves of the organ, and the action of as many muscles consequent upon the sensation thence originating, and the same progress from a mere automatic act to a voluntary effort, and that progress accomplished by means wholly similar. It is well known that boys, long after the time when the evacuation of the bladder has become a voluntary effort, are sometimes subject to an involuntary discharge of its contents. This state hardly amounts to disease, but depends

Digitized by Google

upon an unusual and temporary susceptibility of the nerves of the organ to the stimulus of distension; so that, when this has once reached a certain pitch, the action of the antagonising muscles is of no avail, and the law established between the sensation resulting from that distension and the generation of motor power enforces instant obedience. It is commonly thought that these circumstances are to be overcome by punishment; yet unless the principle upon which punishment operates be strictly kept in view, the unfortunate boy may often, as indeed he often is, be subjected to unavailing cruelty. Punishment can only operate by awakening attention to the first approaches of the sensation; so that the child may anticipate, by an act of will, that degree of distension which enforces the sequence, and which, when it has arisen, no effort of the will, even under the dread of punishment, is adequate to resist.

The process of parturition affords another instance of the dependence of muscular acts on definite sensation; but on this we shall not enlarge, and here also we close our illustrations, observing that although the acts which we have described, and many analogous to them which we might have adduced, agree with proper instinctive acts, in so far as they depend upon sensation; yet there remains a circumstance, which, for the sake of distinction, must be made a ground of difference; and that is, they are concerned in the assimilative functions,—in

Digitized by Google

functions which end in the body itself, while those which are properly termed instinctive, as was before remarked, appertain to the functions of relation.

Such, then, is the general character of the explanation of these actions of the living body, afforded by the doctrine that sympathies operate through the nervous centre. That some objections may be taken to this view is undeniable. These, however, evidently result rather from our imperfect knowledge of the nervous system, and of the actions dependent on it, than from any thing wrong in the principle itself on which the doctrine rests. To say that time will make no change in the explanation we have offered of the phenomena referred to, is the same thing as to assert that no further progress will be made in the discovery of the laws which regulate the operations of the nervous system and other functions of the body. While, however, the subordinate details, and even the language in which the theory is expressed, will undergo a change corresponding to the course of improvement in physiology, there is no ground for the apprehension that the essential character of the theory will be proved to be erroneous, or that the inferences drawn from it by analogy, or otherwise, will not continue applicable in effect, if not in language, to other phenomena. It is very short sighted policy in science, to refuse a theory merely

Digitized by Google

because there may be reason to suspect that in after times, from the advance of knowledge, it will not retain the same character. This is to put on effectual stop to all improvement. Every theory which reduces to one principle a number of seemingly discordant and diversified phenomena—for such a principle cannot be lost or overthrown, whatever change may occur,—claims in science to be received as a truth. It may require to be remodelled, it may change its name, it may seem to be reversed, yet it cannot be divested of its original character, provided it once answered the description now represented to belong to the doctrine in question. We may rest assured, that the principle under consideration will remain essentially unchanged, however much altered and modified in language by future improvements in the science; and this principle, in its most simplified condition, may be stated to be, that an impression, made on the extremities of certain nerves in the first link of a chain of causes, generates, through the nervous centre, motion in muscular organs; and this doctrine, since it first appeared in the works of physiologists, while it remains unchanged in reality, has already undergone several alterations in its details—an index to what new forms it is still destined to assume. Some vestiges of it occur in the works of Astruc, Van Swieten, and Haller, but it assumes a more definite and extended form in the writings of Whytt, the predecessor of Cullen in the Chair of Medicine in the University of Edinburgh. It may be worth while

Digitized by Google

to give an example of his mode of applying it to some of the actions of the body in contrast with the views we would take, and those found in the writings of its chief advocates in modern times, Alison, Broussais, Georget, and Roux. The following passage shews the reasoning of Whytt on the application of the doctrine to the function of respiration, from which it will at once appear how much recent improvements in physiology have served not to change the principle, but to simplify its application :—"It may be asked how a stimulus or uneasy sensation in the lungs, can affect the inspiratory muscles with which they seem to have no immediate connection; I should answer, it were easy to ascribe this effect to a sympathy between their nerves; a phrase, indeed, oftener used than well understood! but, as the pulmonic plexus has no greater connection or communication with the phrenic nerves and those which supply the intercostal muscles, than with the nerves of the stomach, intestines, and other abdominal viscera, which are no ways affected by the gentle stimulus of the blood, as it passes through the pulmonary vessels; I think we cannot fairly ascribe the motions of the respiratory muscles to any sympathy proceeding from a connection or communication between their nerves and those of the lungs. Further, as the nerves of the inspiratory muscles and lungs most certainly do not terminate precisely in the same part of the brain, but probably in places somewhat distant from each other, any sympathy that obtains between

Digitized by Google

them as proceeding from one common origin, must be owing to something equally present in these several places, *i. e.* to the mind or sentient principle; for, without supposing some percipient being in the brain, how can an irritation of the extremities of the nerves taking their rise from one part of that organ, occasion a more than ordinary derivation of spirits, into such nerves as have their origin from a different part? If external objects act on the nerves only by putting a stop to the equable progression of their fluids, or by exciting some vibratory motions in them, how can any of these occasion not only a more copious derivation of spirits through the nerves thus affected, but also through a great variety of other nerves with which they have no connection, and whose rise is from a different part of the brain? The sympathy, therefore, or consent observed between the nerves of various parts of the body, is not to be explained mechanically, but ought to be ascribed to the energy of that sentient being which, in a peculiar manner, displays its powers in the brain, and by means of the nerves, moves, actuates, and enlivens the whole machine.

" But further, if the sympathy observable between different parts of the body be wholly owing to the connection or communication of their nerves, how comes the pupil to be contracted by the action of light on the retina, when the nerves of the uvea have not only no communication with the optic nerve, but arise from a pretty distant part of the brain? or, if there were some general sympathy

Digitized by Google

between the nerves, why should not the longitudinal fibres of the uvea be contracted as well as the orbicular ones, and the coarctation of the pupil prevented? If the alternate contractions of the inspiratory muscles were owing merely to their receiving a few nervous twigs from the intercostals which furnish the plexus pulmonicus, why is not the heart and alimentary canal equally affected with them by a stimulus or uneasy sensation in the lungs? Why are not the intercostal muscles as much convulsed in vomiting as the diaphragm and abdominal muscles? and why, upon an irritation of the membrane of the nose and trachea, are not the abdominal muscles contracted, till the inspiratory muscles begin to be relaxed? These questions will scarce be answered satisfactorily, upon any scheme of *sympathy depending wholly upon the communication or connection of nerves*; but have no difficulty in them, if the motions now mentioned be referred to the mind or sentient principle.

" When, therefore, in consequence of a disagreeable sensation in the lungs, arising from the difficult passage of blood through their vessels soon after expiration is finished, the inspiratory muscles are contracted, we are not to ascribe this to any unknown sympathy acting mechanically upon these muscles or their nerves, but to the mind or sentient principle, which, being affected by the uneasy perception in the lungs, is thereby excited to increase to action of the nervous influence upon the abdominal muscles and diaphragm, by which the

Digitized by Google

cavity of the thorax being enlarged, and the lungs inflated with fresh air, the disagreeable sensation in them is removed, and consequently the extraordinary contraction of the inspiratory muscles ceases; hence, by the reaction of the elastic cartilages of the ribs, abdominal muscles, &c. the cavity of the thorax is lessened, *i. e.*, inspiration is naturally followed by expiration; which again must soon be succeeded by a new inspiration, on account of the particular sensation which begins to arise in the lungs."—*Essay on Vital and Involuntary Motions.* WHYTT'S WORKS, 4to, p. 97.

We have here all that is essential in the principle of the explanation, while, in several respects, the details are in fault. It is true that the blood does not pass so freely through the lungs, when in the state produced by expiration; which fact gives rise to the supposition of a compression of their nerves being the source of their sensation. But the improvements which the advance of chemical science has made on our knowledge of the function of respiration, more particularly as respects the change of the blood from the venous to the arterial state in these organs, affords at once a more intelligible source for the sensation, while it explains at the same time the reason why the activity of the respiratory apparatus keeps pace with every increase in the heart's action. We are, moreover, now able to point out the precise part of the nervous centre, namely, the medulla oblongata, on which this impression acts. And besides, it may

Digitized by Google

be regarded as established, that the mental feeling or consciousness of the impression is not essential but contingent; that is, it accompanies the physical change which we must believe to occur in the medulla oblongata, when the animal is awake and free from coma, but is dispensed with in the opposite states. It is not easy to predict how many improvements on the doctrine as explained above, equally important with those made on it since Whytt's time, physiology may have yet in reserve; indeed, it is not improbable that it is on the eve of a great and most important modification; and it may be observed, that the theory before us had nearly reached its present state before the signal discoveries of Sir Charles Bell of the different functions of the different nerves, and the tracts of the nervous centre from which they respectively originate.

The doctrine of a sensitive and motor tract and corresponding nerves must be regarded as fully established, and, in a great degree, reconcilable with the theory under consideration. But, with respect to the respiratory tract and the corresponding nerves, great difficulties still exist; and, for this reason, we have not attempted to consider the actions which we have been reviewing, in connection with that supposed distinct part of the nervous system. If, however, the labours of anatomists and physiologists shall distinctly establish the existence of the respiratory tract, a great modification of this theory will most probably be required—indeed a total change of the language employed in express-

Digitized by Google

ing it, still, as we cannot but persuade ourselves, without any detriment to the great principle—namely, that such acts as we have described, depend upon impressions on the extremities of one nerve or set of nerves, operating upon other nerves through the medium of the nervous centre, whether the intermediate step be found to consist in sensation or in any other kind of process. And in this we must differ in opinion with our much lamented friend and preceptor the late Dr Fletcher, who, overlooking the identity of principle between Whytt's doctrine and that which he himself inculcates, has failed to do full justice to its merits. A brief outline of that view we will offer; we have not adopted it, partly because the conclusions as to the respiratory nerves are yet very doubtful, and partly because, even supposing those of sufficient probability, it would be difficult to make them sufficiently clear for their popular application to the subject of instinct. But if these views are sufficiently established, it is but a change of language that is required to reconcile them with the theory before inculcated, and its application to the whole range of instinct. The view, then, which Dr Fletcher has adopted, is, that sympathies and instinctive actions are dependent on the respiratory system of nerves. Much difficulty occurs on the very threshold of this doctrine, from the discordant opinions of anatomists as to what are and what are not respiratory nerves, and the no less discordant views of physiologists as to the acts in which they are

Digitized by Google

concerned. If, however, the pneumo-gastric nerve be assumed to be a respiratory nerve, we must admit that the ramifications of that system spread to nearly every organ of the body; there being no difficulty in the belief that that nerve, while it is directly transmitted to the larynx and pharynx, windpipe, gullet, lungs and stomach, is, by its communications with the cardiac and splachnic ganglia, spread to the liver, spleen, bowels, kidneys, bladder, and uterus; and through the branches of the ganglionic system, with which it so freely communicates, over the muscular system of the extremities and other merely muscular parts. It may be supposed, then, that the apparatus of the functions above explained on the views of Whytt, are supplied from this respiratory nerve. The impressions, therefore, such as that of the venous blood in the capillaries of the lungs, the stimulus of cold on the surface, the irritation of foreign substances in the air-passages or nostrils, the presence of aliment in the fauces, the impression of emetics on the stomach, the irritation of feculent matter on the bowels, and of urine in the bladder, are conveyed to the respiratory tract of the nervous centre, and that an affection of it is the immediate antecedent of the transmission of motor power through proper nerves to the muscular organs concerned in the several acts with which such irritations are connected. The following passage from Dr Fletcher will shew that such is the view which he wishes to inculcate: "Thus between the lungs and respiratory muscles, the sym-

Digitized by Google

pathy seems to be maintained by the pneumo-gastric nerve, with which the former are furnished, being associated, at its origin, with the roots of the abdominal nerves, so that the primary irritation calling for the expiratory process excites the abdominal and lumbar muscles to action, more or less violent in proportion to its intensity. And with respect to the sympathy between the lungs and respiratory muscles, the pneumo-gastric nerve is associated at its origin with the roots of the intercostal and phrenic nerves, so that when the primary irritation calling for the inspiratory process is moderate, the intercostal muscles and diaphragm alone are excited; with those of the accessory and external respiratory nerves, so that, when this primary irritation is more severe, the muscles on the front of the neck also, and sides of the chest, are called into action; and with those of the pathetic, facial, and glosso-pharnygeal nerves, so that, on this primary irritation becoming intense, many of the muscles of the eyelids and eyebrows, nostrils, face, and throat, are involved in the general perturbation. The sympathy, again, which subsists between the diaphragm and the muscles which depress the lower jaw, seems to depend upon the associations, at their origins, of the phrenic and facial nerves; between the stomach and diaphragm, of the pneumo-gastric and phrenic, and between the nostrils, larynx, eye, &c., and the abdominal muscles, respectively, of the facial, pneumo-gastric, and pathetic, and the abdominal nerves. Upon the same principle, the

Digitized by Google

sympathy between almost every other organ of the body and the heart, seems to be maintained by the respiratory nerves which are supplied to these organs, being associated at their origins with the pneumo-gastric; that between the nostrils and lacrymal gland by a similar association of the facial and pathetic; that between the mouth and salivary glands of the facial, glosso-pharyngeal, and pneumo-gastric; that between the fauces and stomach, of the glosso-pharyngeal and pneumo-gastric; and that between almost every other part of the body and this latter organ, of numerous other respiratory nerves and the pneumo-gastric. So, also, between the rectum and urinary bladder, and the abdominal muscles, the sympathy may be presumed to be effected by the association, at their origins, of the pneumo-gastric and abdominal nerves; that between the choroid coat and iris upon a similar association of different parts of the pathetic nerve; and that between the ear and gums, of the different portions of the facial. Lastly, the integuments of the armpit, or sole of the foot, appear to extend a sympathy to the expiratory muscles, and indeed to almost all the muscles of the trunk and limbs, by the association of the pneumo-gastric—connected, as it may be presumed everywhere to be, with the several ganglionic nerves going to the surface of the body—and the abdominal and numerous other nerves of the same system. With respect, again, to passion or instinct, the primary action constituting which is always in the brain, and immediately

Digitized by Google

communicated, we must suppose, to the respiratory tract, we have only to find a nerve tending from this part to the organ which is to display the secondary irritation, in order to explain its translation by this system of nerves; and that such a nerve may be always, either directly or indirectly, traced to every organ liable to be so acted on, may be easily inferred from what has preceded." (*Rudiments of Physiology, by Dr Fletcher*, part ii. *b*, p. 40.) There is some ambiguity in the expression "associated at their roots," as it may be designed to teach the ordinary opinion that sympathies depend on the communications between nerves subsequently to their detachment from the nervous centre; but that this is not referred to, appears from the following expression in speaking of respiration,—"In these cases, the translation of the sympathy is from the lungs, through *the common centre* of the respiratory system of nerves, to the muscles in question." (*Note*, p. 40.) It seems obvious, then, that this view—at least when it is remembered that consciousness of the impression is not considered in Whytt's system, as taught by Alison and other physiologists of our time—is no more than a modification of the older theory, such as the discovery of a new region of the nervous centre must demand; for, to repeat what was said before, the theory, as we would inculcate it, had reached a certain maturity before the doctrine of a respiratory tract was taught, and all that appears essentially to belong to it is, that impressions made on the ex-

Digitized by Google

tremities of one nerve operate upon organs of motion through the nervous centre, and not through mere inosculations of nervous branches between the nervous centre and the parts concerned. And this principle, as it was termed in the previous part of this chapter, manifestly pervades and constitutes the essence of both views. While, however, there is this obvious identity of principle in both, it is not therefore immaterial which is adopted. We are bound to follow that which, in the existing state of our knowledge, is attended with the smallest number of difficulties, while it explains the phenomena in an equal degree; and in these respects it does appear to us, that the older view still maintains an advantage. The variety of opinions, indeed, held with respect to the powers of the respiratory nerves, and the particular nerves which rank as belonging to that system, as before noticed, renders it impossible to make use of any function assigned to them just now, as an illustration of any other set of nervous actions; which, it is to be remembered, is altogether the purpose of the present chapter. How far this is the case, will appear from the following short summary of the subject. The respiratory nerves, in Dr Fletcher's table, are the pathetic, the facial, the glossopharyngeal, the pneumogastric, the accessory, the phrenic, and the external respiratory. But the pathetic is still regarded as a simple motiferous nerve by Mayo, Earle, Arnold, and Panizza, while, by Bellengeri and Walker, it is considered at once a vehicle of sympathy and in-

Digitized by Google

stinct. The glossopharyngeal is regarded by Earle and Panizza as sensiferous, the latter representing it as the nerve of taste; by Mayo, as in some of its filaments regular, in others sensiferous only; while according to Bellingeri and Walker, it partakes of the compound character of the facial. The same is supposed to be the case with the pneumogastric; while it is by Mayo accounted a regular nerve; and by Rolando, Brâchet, Earle, and Arnold it is regarded as simply sensiferous, inasmuch as it is supposed to convey certain irritations from the viscera to the sensorium, so as to occasion the sensations giving rise to the desire to breathe, to eat, and the like. Such discordant views with respect to this supposed system of nerves, renders it altogether unwarrantable to found any conclusions by analogy upon their mode of action.

But even suppoing an agreement to exist among anatomists and physiologists as to what nerves belong to the respiratory tract, and what do not, another important difficulty has to be solved in the inquiry what is their kind of action; whether it be all of one kind as the conveyance of impressions to the nervous centre from distant parts or the transmission of specific motor power; or whether, combining functions analogous to the functions of the two other kinds of nerves jointly, they both convey impressions to the nervous centre, differing from those conveyed by the sensitive nerves, in that they do not produce consciousness, while at the same time they, or at least nerves belonging to the

Digitized by Google

same system, transmit motor power to muscular organs. If it be contended that their function is that of specific motion, as exemplified in the pathetic and facial, and on a superficial view, supported by the resemblance of their structure to that of the motor nerves, and by the analogous effect of galvanism on them—then on what principle can they be supposed to be concerned in sympathetic action? for that can only take place through nerves capable of transmitting impressions from their extremities either to their roots, or at least towards their roots, as far as the supposed points of inosculation with the nerves through which such impressions are to be conveyed to the organs where the effect of the sympathy is displayed. If, on the other hand, it be contended that their power is in particular that of transmitting impressions; or, that their function resembles that of the sensitive nerves, with this difference, that no consciousness follows the physical change produced through them in the nervous centre, and the most obvious part of the function of the pneumogastric nerve might bear out this view—what becomes of the whole beauty of the supposed discovery, or what becomes of the system of respiratory nerves deprived of its brightest ornaments?—the pathetic or respiratory of the eye, and the portio dura or lesser sympathetic, the respiratory of the face, not to speak of the phrenic or great internal respiratory, the accessory or respiratory of the neck, and the nerve of the great serratus or respiratory of the trunk, all of which are undeni-

Digitized by Google

ably nerves of mere motion? But let us suppose for a moment further, that this power of transmitting impressions from their extremities to the nervous centre, unaccompanied by any consciousness, is the characteristic property of the respiratory nerves, unaccompanied by consciousness, we repeat, —for if consciousness attends this operation, what are they but nerves of sensation?—by what additional apparatus is it that we are conscious of an uneasy feeling in the chest, when the venous blood, the proper stimulus, by hypothesis, of the extremities of the pneumo-gastric, accumulates too largely; of another, when any thing irritates the membranes of the air-tubes simultaneously with the production of cough; of another, when snuff irritates the membrane of the nostril at the moment of sneezing; of nausea, or a peculiar sensation referred to the stomach, which reaches its height at the instant of vomiting; of an irritation in the rectum, and in the bladder, growing in intensity up to that moment when the force of the natural stimulus overpowers the will, and commands the instant evacuation of these cavities?

It is time, however, without insisting more on the comparative merits of these two views, to proceed to what is more immediately the object of the treatise, namely, the subject of sensation as a course of instinctive acts, and to which what we have already said forms an appropriate, though somewhat lengthy, introduction.

Digitized by Google

CHAPTER VIII.

THE NATURE OF INSTINCT.

As, then, certain organic acts are the direct effect of sensation, so it will be found that instinctive acts, properly so called, can be traced to the same cause, and are, like them, dependent either on external or internal stimuli. It will be advisable to point out, in this place, some of the sources of sensations which become the cause of these phenomena, the most perfect and least equivocal of which are the special senses,—Sight, Hearing, Smell, Taste, and above all, Touch. But besides these there are sensations which acknowledge an internal cause, such as those which accompany hunger, thirst, the sexual propensity, a general feeling of a want, and the like. To these are to be added sensations of consciousness, or sensations of emotion. For as the impressions made on the sentient extremities of nerves give origin to sensations of the most obvious and simple kinds, the seat of which is undoubtedly in the cerebro-spinal axis—so many objects of consciousness, as remembered emotions and passions, the immediate seat of which, as will

Digitized by Google

be seen hereafter, is most probably the brain itself, are to be considered in like manner as the source of sensation, an influence being transmitted, as in the former case, through the nerves, so in the latter from the cerebrum; and in regard to some kinds of such feelings from the cerebellum to the cerebro-spinal axis, the exclusive seat of sensation.

Instinctive acts, then, in the animal kingdom, it being understood those at present referred to are of a relative kind, may perhaps be divided into those which are momentary in duration and those which continue, or seem to continue, for an indefinite period without any very apparent renewal of their cause. Those of the first description are very closely allied to the automatic acts of which notice has already been taken, and the theory of them is comparatively easy; while those of the second description present a greater difficulty when we come to seek a solution of their phenomena.

Let us begin, then, with some examples of those of the first kind, so that we may lay some foundation for the attempt to give a satisfactory explanation of those of the second.

A remarkable instinctive act of the first kind presents itself in the exercise of sight in man and in other animals, the eyes of which are similarly constructed, when the pupil accommodates itself, by a change of diameter, to the greater or smaller quantity of light which happens to be present at any time. When the light is intense, or the bodies presented to the eye highly illuminated, the pupil

Digitized by Google

contracts in diameter, while, in the contrary circumstances, as in the ordinary darkness of night, it expands much beyond its usual diameter in the day time. It is found that this variation of diameter is not dependent on any direct effect of light on the iris itself, but that it results altogether from the kind of impression made by it on the retina, or expansion of the optic nerve, the ultimate seat of vision in the eye. For, when the retina or optic nerve becomes diseased and unfit to transmit the impression of light to the nervous centre, the pupil remains dilated and immoveable, although its own structure remains of the most healthy character. The contraction, then, of the pupil, proportionate to the intensity of the light present, is an instinctive act even in man, and takes place in the following manner:—The impression made by the stimulus of light on the retina, is transmitted according to the ordinary law of sensation to the optic tubercles, that part of the nervous centre on which the sensations connected with vision depend, and a sensation takes place which is proportioned in intensity to the intensity of the impression giving birth to it, just as that is proportioned to the intensity of the light transmitted through the eye to the retina. But this sensation, more or less intense as it may be, is succeeded, in obedience to the general law of such sensations already explained, by a transmission of motor power through the sixth pair of nerves, a filament of which joins the ciliary nerves in the lenticular ganglion, and these are traced to

Digitized by Google

the iris in the middle of which the pupil is,—and by this motor power the circular or sphincter muscular fibres of the curtain are made to contract, and the pupil, consequently, to close its aperture to an extent proportionate to the amount of motor power transmitted, as that is to the original sensation. A very remarkable action similar to this is seen in the singular eye of the Surinam sprat, a reptile capable of adapting its eyes to reflect rays transmitted either by air or water; the refracting power required is different in these two cases, as any one may satisfy himself by attempting to distinguish minute objects placed in water, with his head likewise immersed in this fluid. The reason that he cannot do this is, because, though there is a sufficient difference between the density of the humours of his eye and that of the air, to bring the rays transmitted by the latter to a focus on the retina, there is not a sufficient difference between the density of these humours and that of water, to do the same by rays transmitted by this fluid, so that such rays are not brought to a focus sufficiently soon. Hence divers, in some places, are in the habit, when they descend into the water, of using extremely convex glasses, in shape almost like the lens of fishes, and turning their eyes by this means, as it were, into those of an aquatic animal. But how do reptiles manage this? Not by using spectacles, nor by increasing the density of their humours; but by increasing the distance between the cornea and retina—which they effect by compress-

Digitized by Google

ing the globe of the eye by proper muscles given to them for that purpose—so that the rays which, from the defective refracting powers of their humours, would have otherwise formed a focus *beyond* the retina, now form a focus *upon* it. When again in the air they relax these muscles, and the retina again approaching the cornea, still receives the focus of the rays, which, as passing now through air, are sufficiently refracted for the purpose.

Of the nature of instinct, or perhaps we should rather say of the condition on which it takes place, no better examples can be brought forward. Many other instinctive motions belong to the exercise of vision, more particularly the winking of the eye-lids and the adjustment of the muscles, all of which may be traced as consequences of definite sensations.

With regard to Hearing; the disposition to muscular movements of the extremities, as of the hands and feet, in unison with the time observed by musical instruments, should be regarded as of the same description; it is seen in infants of a few months old. Indeed from the earliest periods, the motions of the hands as expressive of mental affections has been a theme of admiration: "Cæteræ partes," says Quintilian, "loquentem adjuvant, hæ (manus) prope est ut dicam ipsæ loquuntur."*

* "The whole art of the player consists in a delicate perception of the effects of passion on the muscles of the eye, face, larynx, trunks, and limbs, and in an accurate imitation of them, by throwing into the same muscles the stimulus of volition, while he at the same time counteracts, by similar means, the expression of any emotion by which he may be actually excited." —*Fletcher.*

Digitized by Google

In quadrupeds, the inclination of the head and ears in the direction from which sounds proceed, are unquestionably instinctive and necessary in many cases to their security. Hence a frequent and rapid motion of the ears is, in all animals, with justice regarded as indicative of a timid disposition. An instinctive means of adapting the organ of hearing to the medium in which sounds are conveyed, analogous to the eye of the Surinam sprat, is met with in the crocodile, which animal makes the first approach to the well known appendage to the ear, technically called the pinna; being furnished with a kind of external flap, with which it closes the auditory apparatus. It is in this way probably that the animal excludes too intense sounds when under water; but it appears that the greater number of amphibious animals are capable of adapting their auditory apparatus, at least partially, to the medium in which they are, by putting all the parts upon the stretch, by means of the proper muscles, when in the air, so as to qualify them to receive slighter impressions, and by throwing them all into a state of relaxation when under water, so as to prevent them from being stunned by more powerful ones.

The following passages from Whytt (*On Vital and other Involuntary Motions.* Works—4to. p. 79.) afford some interesting speculations on the effect of sensations on the muscular acts connected with hearing. "As without the motions of the pupil, the eye would have been ill contrived for vision in different degrees of light and at different distances, so the ear would have been unfit for hearing distinctly a diversity of sounds, were not some of its parts capable of various degrees of tension. A musical chord of a determinate length and tension, can only vibrate harmonically with one particular sound; if, therefore, there was no mechanism by means of which the membranes of the tympanum and fenestra ovalis could be more or less stretched or relaxed, they could only be harmonically affected by one sound, which, therefore, alone would be heard distinctly, and all others more or less confusedly. To prevent this inconveniency, the malleus is furnished with three muscles and the stapes with one; by the various contractions of the former, the membrane of the tympanum, and by means of the latter the membrane of the fenestra ovalis, is rendered more or less tense, and so accommodated to almost all possible sounds.

"It may well appear wonderful how the ear should be so exactly adapted, by the various contractions of these muscles, to such a vast variety of sounds, but with what exquisite skill and amazing wisdom is every thing in the animal frame adjusted! As the stimulus of light upon the retina and the sensation of indistinctness in near objects excite the mind to contract the pupil, so the less distinct tremor of different sounds affecting the auditory nerves is the cause of the subsequent contractions of the muscles of the internal ear; for no sooner does the mind perceive the first indistinct noise of any sound, but it instantly contracts some of the above muscles, so as most nicely to adapt to it the membrane of the tympanum and fenestra ovalis; if the sound be acute, these membranes are just as much stretched as is necessary for their vibrating harmonically with it; if it be flat, they are duly relaxed; and thus by a simple mechanism, the ear is rendered sensible of the smallest variation of sound or difference of notes in music. As infants seem by habit to acquire a faculty, or at least a greater dexterity, of adjusting their eyes by the motions of the pupil and the crystalline humour to the various distances of objects, so it is not improbable that they may at first hear less distinctly, till by degrees they come to acquire a power of readily accommodating their ears more exactly to different sounds. And is not the want of an ear (as it is usually called) owing to a deficiency of this power? While that exquisite discernment of musical sounds which many possess, shews that they can adjust their ears to different notes with the greatest accuracy.

"That the motions of the muscles of the internal ear proceed from the mechanical action of sound or vibrating air on their fibres, the analogy of the motions of the pupil would seem to contradict. And if this were the case, why should not all the muscles of the malleus be equally contracted by the same sound? And why should those which serve to stretch the membrane of the drum be excited into motion by acute sounds, while the muscle which relaxes it is only brought into action by

Digitized by Google

grave ones. As brute animals, upon the first perception of any noise, turn their external ears towards the place from whence it comes, so at the same time they adapt their internal ear to it; the first of these motions cannot be denied to flow from their sentient principle actuated by the sound, why, then, should we doubt that the latter proceeds from the same cause?

"The motions of the muscles of the internal ear, in consequence of various sounds, are not only unattended with any consciousness of volition, but are altogether involuntary; for we cannot move them except when sound strikes the ear, nor hinder them to act when it does."

But the great source of instinctive acts in the lower animals, are the senses of Smell and Taste. By these, particularly by the former, they are led with unerring certainty to the selection of their food. Of herbs they reject such as are noxious, while they select those which are salutary, with a certainty which far exceeds the boasted knowledge of man: yet what is this but an original connection between [illegible] muscular movement necessary for cropp[illegible] herbage and the sensations which the [illegible] of it excites? How wisely adjusted to eac[illegible] must be the two processes, and how re[illegible] inferences of the goodness and greatne[illegible] ator! but the animal kingdom ever[illegible] ds with such, and innumerable [illegible] re inadequate to impress us with

Digitized by Google

more than a faint idea of the stupendous extent to which these attributes are displayed. There is scarcely a plant which is not refused by some while it is eagerly sought after by others. The horse rejects the common water-hemlock, on which the goat luxuriates; the cow refuses the long-leaved water-hemlock, which the sheep is greedy for; and the goat will not touch the wolf's-bane, which the horse enjoys. The Indian buceros devours with avidity the nux vomica, so well known as poisonous to dogs, rats, and most animals; and the land-crab feeds on the berries of the deadly manchineel tree. The deer and the round-horned elk thrive on the broad-leaved kalmia, which is poisonous to sheep, horned cattle, horses, and man. From the flower of the same plant, the bee draws honey, and man finds death.* Parrots are poisoned by parsley, hogs by pepper, and fowls, dogs, and foxes by sweet almonds; whereas fowls are uninjured by darnel, and pheasants by stramonium, hogs thrive on henbane, and storks, like sheep and goats, on hemlock, the last again are uninjured by tobacco.

Many sensations originating in the qualities of the atmosphere at certain times, are the source of instinctive actions, momentary as well as more continued. These are not less marked in animals, than, from the same cause, are the effect of the seasons upon vegetables. With the first appearance of the renovating spring, the wood-lark renews its note, the thrush retunes his throat to melody,

* *Smellie*, i. 350. *Hancock*, 24.

Digitized by Google

and the rook revisits its breeding-tree to make choice of a nest for the approaching summer. Flowers and trees acknowledge the glad influence in their many tinted blossoms, their opening buds, the bloom which is beauty, and the fruit-promising blossom. The trouts, too, begin to rise in the stream, and the water-fly skims along the surface of the secluded pool, and, if the day be fine and warm, the brimstone-winged butterfly issues from the wood to enjoy the sunshine; the ewe drops her lamb; the sparrow builds its nest; and when Hesperus glimmers o'er the southern hill, the bat comes forth on restless wing to spend an hour in dalliance with evening, till scared to its ivy bed by the darkening shades of night. As spring deepens into summer, the air murmurs with exulting insects, and bush and brake, "hymning their great God," send forth their voice of melody. But as June melts into July, the music of the groves makes a pause, or is confined to the wren and a few tiny companions.

Autumn, in like manner, exerts its peculiar and proper influences, and among these none are more remarkable than the instinctive acts evidenced in the migrations of animals,—inducing them to undertakings reason would not have dared to prompt, and which volition would have been inadequate to accomplish; few subjects are more interesting or have called forth more notice; to almost all they are familiar, and the inspired seer found in them an illustration suited to his purpose: "The stork in

Digitized by Google

the heaven," says Jeremiah, "knoweth her appointed times; and the turtle, and the crane, and the swallow observe the time of their coming." But soon the cold night, and the shortening day, and the declining sun, and the departure to warmer climes of many a feathered visitant, and the fading leaves tinting the woods with a varied livery, proclaim stern winter is at hand—that night of the year when Nature sleeps and rests her from fatigue. The sensations now imparted have called forth new instincts in animals; numerous tribes have provided for themselves comfortable retreats, burrowing in the earth, boring beneath the bark of trees or penetrating their natural hollows, lodging in crevices of walls and rocks, or diving beneath the surface of the water. Here some are preserved during this period, either by feeding on the stores they have collected during the bountiful weeks of harvest, or by falling into a deep sleep, during which they are unassailed either by hunger or by cold. "Who knoweth not in all these, that the hand of the Lord hath wrought this" by the gift of an organization enabling an animal to perceive the approaching changes of weather, which stimulate to acts dependent on an established connection between the sensations arising from the impressions made on their delicate organs by variations in the humidity, dryness, temperate, and electrical states of the atmosphere, and the movements which they are observed to perform. Animals are conscious long before man of the approaching storm, and prepare for its

Digitized by Google

coming; in the woodlands the birds hush their song, in the meadows the flocks bleat in dismay, and on the mountain side the lowing of the cattle is wild and desolate; but Dr Jenner, in his signs of rain, giving as an excuse for not accepting the invitation of a friend, well illustrates our position, and spares us more remarks upon the subject:—

"The hollow winds begin to blow,
The clouds look black, the glass is low,
The soot falls down, the spaniels sleep,
And spiders from the cobwebs creep.
Last night the sun went pale to bed,
The moon in halos hid her head.
The boding shepherd heaves a sigh,
For see! a rainbow spans the sky.
The walls are damp, the ditches smell;
Closed is the pink-eyed pimpernel.
Hark! how the chairs and tables crack;
Old Betty's joints are on the rack.
Loud quack the ducks, the peacocks cry;
The distant hills are looking nigh.
How restless are the snorting swine!—
The busy flies disturb the kine.
Low o'er the grass the swallow wings;
The cricket, too, how loud it sings!
Puss, on the hearth, with velvet paws,
Sits smoothing o'er her whisker'd jaws.
Through the clear stream the fishes rise,
And nimbly catch th' incautious flies;
The sheep were seen, at early light,
Cropping the meads with eager bite.
Though June, the air is cold and chill;
The mellow blackbird's voice is still.
The glow-worms, numerous and bright,
Illumed the dewy dell last night;

Digitized by Google

At dusk the squalid toad was seen,
Hopping, crawling, o'er the green.
The frog has lost his yellow vest,
And in a dingy suit is dress'd.
The leech, disturbed, is newly risen
Quite to the summit of his prison.
The whirling winds the dust obeys,
And in the rapid eddy plays.
My dog, so altered in his taste,
Quits mutton-bones, on grass to feast;
And see yon rooks, how odd their flight
They imitate the gliding kite;
Or seem precipitate to fall,
As if they felt the piercing ball.
'Twill surely rain."

All the acts we have just enumerated as occurring in the animal kingdom, are in strict accordance with impressions made on the nerves, and founded neither on accident nor reflection. It is thus, as Shakespeare observes,—

"That when the dawn, in russet mantle clad,
Walks o'er the dew of yon high eastern hill,
* * * * *
The cock, that is the herald of the morn,
Doth with his lofty and shrill sounding throat
Awake——"

And it is from the same impression of light that the greater part of the animal kingdom are stimulated to activity with the approach of sunrise, while they retire to repose as it sets; and, as has particularly been remarked of birds, if an eclipse occurs, they still obey the impulse of sensation, retiring as darkness comes on to return to their fluttering and chirp-

Digitized by Google

ing as it subsides. Expecting the annular eclipse on the 15th of May last year, we were wandering in the ducal gardens at Mannheim on the Rhine. In the full glare of sunshine that preceded the approaching phenomenon, the close thickets of the gardens, overgrown with brush and underwood, were redolent with songs poured from a thousand little throats of the groves' sweetest choristers. But as dimness threw her mantle on the earth, all was hushed; there was no sound save that of dreamy stillness which the poet only hears, whispering to his soul unearthly words. For a few moments it continued, feeding our hearts with fancies wild and strange. But no sooner did dimness begin to deepen into shade, and darkness, like that of evening, shed its influence around, than the voice of the nightingale burst upon our startled ear, "warbling his sweet notes, as if he feared the night would be too short to utter his love chant."

Hunger rouses the beast of prey to the chase, and the sensation of thirst stimulates it to long journeys in quest of water. It is an indefinite desire, and independent of any deliberate object in resisting danger, or procuring food, that excites the herbivorous tribes to be gregarious, as it does the carnivorous, to avoid their fellows; and it is in the same way, and not from the possession of definite weapons, that the bull and ram are prompted to butt with their horns, the horse to kick with its hoof, the cat to seize and scratch with its claws, the dog

Digitized by Google

to snap with its mouth, and the cock to strike with its spurs.

The sensations dependent on the sexual secretions are of vast importance in producing instinctive acts, and from them result many of the peculiarities observed in different species of the animal kingdom. The degree of desire, indeed, which prompts individuals in the defence of their young, appears to amount to enthusiasm. All enthusiastic acts, it is well observed by Dr Fletcher, are instinctive, and, therefore, in our own species, frequently such as to surprise even the enthusiast himself, on again subjecting himself to the sober dictates of reason and volition. They are like those of a person partially imbecile or insane; and if a special providence sometimes seems to preside over the actions of an idiot or a maniac, it is only because he is actuated under circumstances of difficulty, by a power less fallible both in its end, and the means employed to attain that end, than reason and volition. It is hence easy to understand how in the lower animals, the blind impulse of instinct should often supersede reason, and be competent to excite numerous actions, corresponding to those which, in man, can be excited only or chiefly by volition. Thus when the latter would construct a fabric of any kind, he proceeds upon a plan more or less deliberate, and adopts means which are at first, in a greater or less degree, inadequate to the end in view; and it is only after efforts more or less frequently repeated, —and that not by himself alone, but by his fellows

Digitized by Google

for many succeeding ages,—that he attains any thing like perfection in his manufacture. But the snail in constructing its shell, the spider its web, or the silk-worm its cocoon, the bee in building its comb, the bird its nest, or the beaver its hut, without any deliberation, adopts at once the most effectual means of attaining a certain end; and the resulting fabric is as perfect the first time it is attempted, as it can ever by any possibility become. These are the criteria of instinctive, as distinguished from rational actions; and the more nearly man, in attaining perfection in his works, approaches to these conditions,—in other words, the more he is actuated in their production by instinct,—the greater is his genius; the more by reason and volition, the greater is his talent. And upon this principle is explained why a man of genius is generally a bad dissembler, and a man of talent a good one; in the former, the instinctive impulses preponderating, in the latter the rational;—no one can be a hypocrite in whom the feelings preponderate over the judgment. It is most erroneous to imagine that we detract from the proper rank of the lower animals by representing them thus, with respect to many of their actions, as a kind of automaton; since we are, in fact, raising them to that of artists, acting under an impulse which man conceives it glorious to obey. It is this consciousness of a power superior to any over which we have control, which has led poets in all ages to invoke Apollo and the Muses to inspire their verse,—in other words, to call upon passion or instinct to supersede reason; and that some such instinctive power at once absorbed the mind, and actuated the mighty hand of a Michael Angelo and a Raphael, and excited, not only the conceptions, but the merely physical movements, destined to develop works on which ages were to ponder with admiration and delight, is unquestionable. It is said of Paesiello, that, in his fits of composition, he used to bury himself under the bed-clothes, trying to banish from his memory all the rules and precepts of his art, and giving vent to his feelings in the exclamation, "Holy Mother, grant me the grace to make me forget that I am a musician." It is true that the instinct thus running riot over the reason, is, in man, very liable to become morbid, and even to terminate in confirmed idiotism or insanity; and numerous melancholy instances of partial or total imbecility or madness, as a concomitant of the "fine phrensy" of poesy, might be adduced from among the poets of every age:

> "Great wits to madness sure are near allied,
> And thin partitions do their bounds divide."

It is this constant subserviency of many of the actions of a great genius, and of a fatuous or furious person, to the same blind impulse, which produces that close alliance of the sublime and the ridiculous, the lofty and bombastic,—as well in works, as in thoughts and words,—which has furnished in every age, so fertile a theme of animadversion. Both equally recede from the reasonable; and the only

Digitized by Google

difference between them appears to consist in this, that, while the former so far carries with it the mind of the judge as to warp his judgment, by inspiring him with some degree of that enthusiasm in which the conception originated, the latter fails in this object, and, by leaving him in full possession of his reason, stands exposed at once in all its native deformity. An unhappy point in the most majestic statue or picture, like an ill-timed word in the most elevated sentence, frequently has the effect of suddenly awakening us from a day-dream of admiration;* and what we were perhaps about to pronounce a model of the grand, becomes at once a beacon of the ludicrous: the insignia of royalty differ only in the spirit in which we contemplate them from the tinsel of punchinello. It is a similar morbid preponderance of instinct over reason which leads man into every description of intemperance; although this results much more frequently from the reason being too weak, as in the case of ordinary debauchees, than from the instinct being too strong, as in that of men of genius, who are unhappily so often characterized by this infirmity; as il-

* The spinous processes of the vertebræ of serpents are so constructed, that the motions of their spinal column are not only, or chiefly, lateral, but in a great measure upwards and downwards also. Some painters and statuaries, however, appear to have overdone this matter, and to have represented flexures in the bodies of serpents where no countenance can be given to them by anatomy. There are limits, in this respect, beyond which we cannot allow even the sublime hand of the sculptor of the Laocoon to pass without reproach.

Digitized by Google

lustrative of this, it is sufficient to mention Rochester, Parnell, Otway, Sheffield, Savage, Churchill, Prior, and Burns. Nevertheless, let those, as remarked by Dr Currie in his life of the last, who are without follies, cast the first stone at their infirmities, and thank their God that they are not, like the poor children of genius, frail in health, feeble in resolution, in small matters improvident, and unfortunate in most things.

But, inquires Dr Fletcher, to whom we are indebted for the above illustrations, if instinct, thus opposed to reason, sometimes betrays man into errors, is reason, when opposed to instinct, quite exempt from a similar imputation? Whence have originated all the absurd attempts, made by reputed philosophers, from the earliest periods, to counteract the natural tendencies, as well of brutes as of man, and to make them what nature never designed that they should be? What was it that has led some of them to forbid us to sit near the fire when we are cold, lest peradventure we should dry up our radical moisture; or to court the refreshing gales of heaven when we are in a fever, lest perchance we should interfere with the salutary fermentation of our fluids? What was it which has prompted some to the idle attempt to make aquatic animals terrestrial, and terrestrial aquatic; to render herbivorous creatures carnivorous, and carnivorous chewers of the cud; or to turn quadrupeds into bipeds, and bipeds into quadrupeds? Whence have arisen the injunctions, which we are

Digitized by Google

condemned still sometimes to hear, not to eat when we are hungry, nor to drink when we are thirsty, and to feed exclusively on herbs and fruits, and water from the spring,* or, at any rate, to be satisfied with the least possible quantity of the simplest fare? What formerly induced our boarding-school mistresses to endeavour to improve the shape and carriage of the poor things committed to their care, by debarring them from all natural exercises; and what is now leading them, with almost equal absurdity, to attempt the same by all sorts of unnatural gymnastics and calisthenics? There are few who have not, at one time or other of their lives, tried to supersede their instinctive and wholesome impulses by some *rational* system of diet and regimen, and there are few who have not found themselves the worse for their pains; and if man is more prone to deformity and disease than any other animal, he perhaps owes a great part of the melancholy distinction to so frequently allowing the artificial precepts of reason to interfere with the natural dictates of instinct. We may distort the propensities, as we may deform the skull like the Charib, or the nose like the African, or the foot like the Chinese; but we cannot improve them.†

* The principal patrons of this twaddle in modern times—to say nothing of Pythagoras and the ancients—have been Gassendi, Rousseau, Willis, Lamb, and Newton, the last of whom asserts that *real* men have never yet been seen, nor ever will be, till they shall be content to subsist entirely on herbs, and fruits, and distilled water!

† *Fletcher*, Part ii. β, pp. 19–20.

Digitized by Google

But to return from this digression, the sense of an ungratified want, though less distinct in its character than others we have mentioned, is not the less the origin of many instinctive acts of which we shall hereafter speak.

The sensations arising from the consciousness of the actions of the muscular frame become a new source of activity; and it will be found to play an important part in the economy of instinctive acts. The pleasure which results from them, especially in the young, appears to be one of the chief enjoyments in the existence in animals. We see the young steed bounding over field and meadow glorying in the consciousness of his powers; and the delight which the lambs in spring display in the exercise of their speed, is one of the most pleasing contemplations in nature. It has drawn strains that will never die from many a poetic mind.

The last order of internal sensations on which instinctive acts depend, are those of Emotion. Of this are all the forms of the expression of emotion or passion in man and the higher animals, as seen in the aspect of the countenance, and the attitudes of the body. These, as connected with emotion or passion, give one of the best illustrations of the philosophy of all instinct; for the muscles concerned are all voluntary, yet here assume definite combinations of action wholly independent of the will; and in the human race, the acts of expression in particular, are so numerous, that they must equal, if they do not exceed, the various movements ne-

Digitized by Google

cessary in other animals for the ends of their relative existence. It is perhaps true, as Sir Charles Bell remarks, that there is no expression in the face of any animal lower in the scale than the quadruped; yet the same limitation is not to be extended to the action of the eye, and the attitudes of the body, which occur in correspondence with emotion in birds and reptiles, as in mammals. The fire-like flashing, the fascinating power of " the magic circle of the eye," is no fable; and as remarkable in some reptiles as in man. The increased brilliancy in the eye of the rattlesnake from desire, and in which appears to consist its reputed fascinating power, is well known, and seems to have suggested to Milton the idea of endowing the serpent in the Garden of Eden with a similar property,—

> " —— its gentle, dumb expression turned at length
> The eye of Eve :"

the erect bearing of the common cock after victory, and the perching aloft to crow over his vanquished rival, and the dejected mien of the conquered; the swagger of the turkey-cock, and the amorous movements of the pigeon, are so many muscular acts determined by sensations of emotion. Again, the sudden inflation of the Diodons and Tetradons among fishes when irritated, so as to render all their spines erect; and the violent instinctive movements by which many other species inflict, in the same manner, severe wounds on their aggressors; and the pouching of the neck of the cobra-da-capello, among reptiles, from agitation,

Digitized by Google

are instances of the influence of passion on the action of muscles generally voluntary.

The number of movements of this kind, however, in the inferior animals, falls very far short of that which is observed in man. Thus in carnivorous animals, the expression most marked is that of rage :—the glaring eye is fixed, the lips are retracted, the canine teeth are exposed, and the attitude of the body is such as collects the whole energies of the muscular frame, and concentrates them for attack. In graminivorous animals, as the bull, the eye assumes a wild and fearful character, the nostrils become dilated, the horns are directed obliquely downwards, while the rest of the face, especially the lips, remains calm and placid. In the horse, the expression of the eye and nostril, and the motions of the ears, mark the same state of emotion. Rage and fear seem to be the chief sources of expression and attitude in quadrupeds; but in man there is no emotion which is not attended by its corresponding indication on the muscles of the face, so truly said to be the index of the mind. In the expression of rage, the " human face divine," combines, to a certain extent, the muscular actions of both herbivorous and carnivorous animals ; the eye sparkles, the notrils are dilated, while the canine teeth are in part exposed, to which is added the knitting of the eyebrow, an act of which other animals are incapable, and the cause of the peculiarity of the expression of the emotions in the human countenance.

Digitized by Google

In laughter, peculiar to man,* the outer-half of the eyebrow is drawn down, the mouth is open, the teeth appear, the angles of the mouth are drawn backwards and upwards, the nostrils are dilated, and the cheek raised.

In weeping the brow is drawn down, the cheek raised, the nostril drawn up, and the mouth stretched laterally, the part of the eyelid next the nose is elevated, while the corners of the mouth are depressed.†

* Milton says that—

——— smiles from reason flow,
To brutes denied.

The reverse, however, of the first part of the proposition holds good; the act is purely instinctive, and reason is not concerned in its production.

† The only brutes said on good authority to weep from sorrow, are some species of monkey, the seal, and the camel; the first species by Humboldt, the second by Steller, and the last by Pallas; the dog, however, should certainly be added to the list. The alleged "big, round tears," of the deer, the hare, and other animals when hotly pursued, are in fact only sebaceous matter, which, under these circumstances, flows in profusion from a collection of follicles in the hollow of the cheek; and the far-famed "crocodile's tears," although *bona fide* tears, do not flow from affliction. But if crying is not confined to man, he is perhaps exclusively "a laughing animal," as he has been sometimes defined, no brute apparently being capable of that sense of the ridiculous, arising from incongruous associations in which laughter orginates. The laughing of the hyæna, it needs hardly be observed, furnishes no exception to the remark.

And if man stands almost alone in his susceptibility of a flow of tears from affliction, and of laughter from mirth, it is, per-

Digitized by Google

In joy the eyebrow is raised moderately without angularity, the forehead is smooth, the eyeball lively and sparkling, the nostril slightly dilated, and the lips smiling. In all the exhilarating emotions, the eyebrow, the eyelids, the nostrils, and the angles of the mouth are raised; while in all depressing passions the reverse is the case. In discontent the brow is wrinkled, the nose peculiarly arched, and the corners of the mouth drawn down to a great extent. But for descriptions of other kinds of expression, we must refer to the authors who have written on the subject, particularly to Sir Charles Bell's Anatomy of Expression, to whom we are indebted for much information on the subject. That such combinations of muscular contraction are of the same nature as instinctive acts cannot be reasonably doubted; they are independent of the will, and although they do not display themselves in an equally marked manner in every individual, yet the muscles concerned, and the mode, if not the degree, of their action, is one and the same in all mankind. It has been questioned, however, if these are properly ranked with sensation; and what can be said on that point chiefly is, that this has been a common plan of arrangement among physiologists, and even allowing it to be no more than a convenient mode of classification, we shall not be

haps, not because there is no tendency in other mammals to the same actions from the same primary stimuli, but because they are in general incapable of the peculiar emotions in which these primary stimuli consist.—*Fletcher*, Part II. *β*.

precluded from insisting on the proposition that the sources of instinctive acts are reduced to two—certain states of sensation and certain forms of emotion. Nor should it be required of us to shew any further connection between what is here assigned as the cause and the effect in question. It is enough if there be an uniform observation of a sensation or emotion as the antecedent of every instinctive act, to entitle the one or the other to the name of cause. It is possible that some intermediate step between the two acts may hereafter be discovered; but in the mean time, as was before observed, we must be content to view the connection between them as simply established by the Almighty will.

It would be improper to leave this part of our subject, and proceed to the consideration of instinctive acts of a more permanent kind, without alluding, as illustrative of them, to the effects of emotion on other parts of the body than the muscular. We shall confine ourselves, however, and that briefly, to the functions of secretion and absorption.

These are remarkably affected by emotion. In intense grief and in fear, the secretions, at least some of them, are altogether stopped; the tears do not flow, and the saliva is suppressed; the absence of the latter, causing the cleaving of the tongue to the roof of the mouth—the *vox hæret faucibus*—the *passio hysterica* of poor Lear—has been turned to account in the detection of a thief in an establishment of servants, by the dryness of

Digitized by Google

the rice which he, in common with the rest, had been compelled to hold in his mouth, while each was taxed with the theft. From grief, in a few hours the hair has become perfectly blanched; and the same emotion in a canary-bird, from the loss of its mate, has been known to cause a change in the colour of its feathers. We have a case in our recollection where, from intense and sudden grief in a woman who was nursing, the milk entirely, and in a very short time, left her breasts. From bad news the breath will become instantly fetid; and not only is the halitus from the lungs vitiated, but the secretions also, which are at the same time increased in quantity. From bashfulness, the sebacious discharge from the surface assumes so unpleasant an odour, that the poor sufferer is often unjustly accused of uncleanliness; and all persons must be aware how suddenly, from dismay, the whole body is bathed in sweat. The phrase "green-eyed monster," is correctly applied; jealousy, as Horace says, making the liver swell with bile and causing jaundice. By fear the alvine secretions are changed in quantity, consistence, and odour, as every boy who has been threatened with a caning, will well remember; and when cholera raged among us, this had no little influence in the spreading and propagation of the epidemic; fear soon brought on a bowel complaint; a predisposition to the disease was thus established, which soon followed to claim its unhappy victim. In joy the tears often flow; while, as we before remarked, in intense grief they are suppressed, and

Digitized by Google

when they do flow it is a proof of moderated sorrow; tears do not bring relief, as is commonly supposed, but they indicate that it has been brought. In hilarity and in despair fat is abundantly secreted; and hence "despair and grow fat" would be as true a saying as "laugh and grow fat." Persons left long to pine in condemned cells, without a shadow of hope, become frequently, in spite of their slender fare, remarkably stout. Absolute despair, as Dr Fletcher justly remarks, is as incompatible with solicitude, as total thoughtlessness; and it is solicitude which emaciates. Cassius was "lean," because he was anxious to redress his country's wrongs; had he either been indifferent, or despaired of redressing them, he would probably have been as "fat and sleek-headed," as any of those whom Cæsar wished to have about him.

Nature has rendered the increase and vitiation of certain excretions, under emotion, a means of defence and security to many animals. The cuttle-fish, among avertebrated animals, conceals itself, when in danger, by colouring the water black with the matter discharged from its ink-bag. Among reptiles, the increase and vitiation of the cutaneous exhalation of the alliaceous and mephitic toad, when irritated; and the bath of sweat which, under similar circumstances, envelopes the salamander, and that to such an extent, that it has been known, not indeed to extinguish, but to escape from, a fire into which it was thrown, are likewise instinctive acts, and the effects of

Digitized by Google

emotion. The diodons and tetrodons, among fishes, inflate themselves, under the same circumstances, by the compound consequence of the effects of emotion upon their muscles, to which we have alluded, and the sudden secretion of air. The vulture uses the contents of its stomach as a great means of defence; from fear, the odour of this becomes highly vitiated, and when pursued, the bird voids in the face of its pursuers a mass so intolerably fetid, that they are compelled to desist from the pursuit. The American skunk uses its intestinal secretions in the same way. Many animals, again, change colour from emotion,—analogous, perhaps, to blushing in man; of these we may mention, among reptiles, the chameleon; among fishes, the perch and stickleback; and among birds, the turkey-cock, as is seen in his wattles.

We might greatly add to this catalogue, but refrain from doing so; simply observing, that all the acts we have mentioned are of the same nature as instinct, and to be referred to emotion.

The foregoing slight sketch of some of the sources of those instinctive acts which are of a less continued kind, is a step towards connecting those of a more prolonged character with the same principle.

It was before remarked, that every muscular act of a relative kind is the source of a new sensation; that is, an animal is conscious of the contraction of the muscles concerned in such acts; and hence a single muscular act originating in a sensation,

Digitized by Google

as it gives rise to a new sensation, may become the source of other muscular acts, which, being in turn the source of sensations, produce in succession other acts, so that a continued and connected train of instinctive acts may thus proceed in a manner wholly analogous to that in which a single momentary act arises. The limit to the continuance of such a train of acts, is the fatigue or exhaustion, alike, perhaps, of the nervous power and the muscular force; which, being renewed and refreshed by rest, the same stimulus, whatever it may be, will be capable of setting again in motion the former succession of acts. Again, the sensation accompanying an ungratified want, as it may continue a long time, seems capable of giving rise to prolonged acts, just as momentary sensations produce temporary acts. Another source of continued action may be conceived, without any violation of the same principles, in the new impressions made on the senses, as of sight or touch, by the effects of the first acts on surrounding nature; for example, in constructing a nest, or a habitation of any sort, the sight of the first steps in the work may be regarded as so many sensations on which the continuance of the necessary acts depends. The application, then, of these propositions, seems to bring continued acts of instinct under the same general law as those above noticed; while, at the same time it must be admitted, that our assent to the explanation in the case of these is less readily afforded.

Digitized by Google

The most remarkable instances of continued acts of an instinctive kind are found in the construction of habitations by the beaver, the nests of birds, the comb of bees, the cocoons of silk-worms, and the webs of spiders; also in the migrations of birds, land-crabs, &c. These, however, we shall not enter more fully upon, further than to remark, that the first of these animals, which, in its native haunts, seems to exhibit the most remarkable effects both of reason and instinct, belongs to an order of mammals by no means distinguished for the general development of their brain, or of those parts in it which are most perfect in man, the quadrumana, and carnivora. Like the other rodentia, the beaver is destitute of the convolutions on the surface of the brain, so distinguishing a characteristic of man and the higher animals. This might lead us to the proposition that instinctive powers are more produced when the organ on which reason depends is less developed.

It may be added, as illustrative of the connexion between instinct and certain definite sensations, that the beaver, when removed from its native wilds, becomes an extremely stupid animal.

In what has been called the accommodating power of instinct, some evidence is obtained of the necessity of definite sensation to call forth its phenomena; although, in some instances of this kind, a degree of reason must be supposed to bring about the change on the habits of the animal. Thus, in Senegal, the rabbits, as Adanson relates, do not

Digitized by Google

burrow, that is to say, that the sensation of cold, which must be presumed to be the cause that determines them to that act elsewhere, is not there applied. In the same country the ostrich sits upon her eggs only by night, while at the Cape of Good Hope she incubates both by night and day. This, like every other bird, occasionally leaves her eggs; and the sensation imparted from their coldness on her return, must be the cause by which her sitting is kept up. If, then, no such cooling takes place during her absence by day in the warm climate of Senegal as at the Cape, the condition on which her assiduity depends does not take place. Many birds, again, build their nests differently in different places, —the difference being evidently connected with a difference in the climate, and other circumstances of the situation. Many of these differences may be traced to differences in the sensations produced by variety of climate and circumstances; but some of them must be referred to reason in the first instance,—in the progeny, perhaps, to the transmission of acquired qualities. Thus it is said, that, in countries infested with monkies, birds which in other places build in bushes and clefts of trees, suspend their nests on slender twigs, so as to avoid the attacks of their predacious enemies. It does not clearly appear how such changes in the habits of these birds can be referred to instinct,—unless we say that new sensations beget new instincts. That such is the case is undeniable, yet, in the present state of our knowledge, it is perhaps more ju-

Digitized by Google

dicious to refer such changes to experience, thus admitting a reasoning principle. But suppose it be found that every new brood proceeds in the same manner as the parent birds, without any apparent source or time of instruction; then we must refer it to the transmission of qualities acquired by the parents to their offspring,—that is, what was acquired by the parent birds at some previous time by reason becomes transmittable to their progeny as an instinct. It is certain that acquired qualities, however little it may be the case among men, are transferred to the offspring among the inferior animals, and that in no slight or unequivocal degree. Every one has seen, or at least has heard of, the tailless cats of the Isle of Man, and of the dock-tailed dogs of the southern counties of England; and it cannot be doubted but that these two breeds arose from the mere cutting off of the tails of certain parent cats and dogs, while the breed was confined from admixture with those who enjoyed the full plenitude of their caudal appendages. A cat of this variety breeding with a common cat, produces a litter of kittens with very short tails; and the peculiarity will, by a repetition of the experiment, soon disappear. That the peculiarity is originally induced by the simple mutilation of the tails of the parent animals, is proved by an experiment referred to by Haller, in which a common cat, from which the tail had been purposely removed, brought forth a litter, some with tails and others without. A fact is recorded in some books of natural history,

Digitized by Google

which bears more closely on the present argument. In some parts of America, it is the practice to hunt herds of a species of deer with trained packs of dogs; the dogs are taught to attack the herd in line, and by this method never fail to be successful; but if any of the dogs be led by excessive ardour to break into the herd singly, they are sure to be completely destroyed. This uniformly happens to untrained dogs, whatever be their strength and courage. But the offspring of dogs which have been fully trained to this kind of warfare, require no education, but at once fall into the only kind of attack which can be attended not only with success, but their own personal safety.

A more minute acquaintance with the animal kingdom will doubtless enable us to point out many sensations governing the instincts of animals, at present unknown to us; for every day's experience adds something to our knowledge on this head, even although the subject has seldom been investigated on a proper plan. The migrations of birds, in particular, offer a wide field for the illustration of this subject, as connected with the changes of temperature, and other qualities of the atmosphere, the failure of food, and the like. One curious fact which we may mention, as recorded some years ago, offers a kind of key to such inquiries. In the neighbourhood of the Carron iron-works, where the temperature of the air, to a considerable extent around, must be very much above that natural to the climate, swallows are said to remain the whole winter.

Digitized by Google

Indeed the experiments of Mr Pearson, as detailed by Bewick, puts the question beyond a doubt. Having obtained some swallows, he placed them separately in cages in a warm room, feeding them with nightingales' food, and guarding their feet from the effects of damp and cold, by covering their perches with flannel. This precaution was adopted because, in a former unsuccessful experiment, the birds' feet had swollen and inflamed, as was supposed, from this cause. "He had the pleasure to observe that the birds throve extremely well; they sung their song throughout the winter, and soon after Christmas began to moult, which they got through without any difficulty, and lived three or four years, regularly moulting every year at the usual time. On the renewal of their feathers, it appeared that their tails were forked exactly the same as in those birds which return hither in the spring, and in every respect their appearance was the same." The propensity to migration, then, does not arise in these cases, because, so long as the birds are confined within a certain boundary, the sensation arising from a declining temperature does not affect them. And further, it is probable that the same elevated temperature prevents, in their wild state, any deficiency of their usual insect-food throughout the winter.

The instinctive actions of animals, then, it can hardly be questioned by any who reflect upon the subject, are referable to some uneasy sensations, in like manner modifications of touch or tact, proceeding from certain irritations of particular organs.

Digitized by Google

Thus,—to begin with some of those which the inferior tribes of animals have in common with man,—can it be doubted that the instinctive actions of keeping themselves warm, and of taking food and drink, spring from uneasy sensations, originating in certain irritations respectively of the skin and the stomach, and prompting us to use the proper means of removing them? "The perception of these irritations," it has been well remarked, "is the monitor by which we are warned of the necessity of effecting some change in the system; and it is a monitor, the voice of which it is not possible either to disregard or misunderstand, since its importunity increases in proportion to the increased demand for such a change, and its injunctions are enforced by laws far less fallible than those of reason." And if it be conceded that the instinctive actions just mentioned originate, not in thought, but in sensation, how can it be reasonably questioned that others, in every respect so nearly allied to them, have likewise their source each in some uneasy sensation, arising from a specific irritation, and urging animals to adopt the only proper means of getting rid of it, in the same way as coldness of the surface prompts us to huddle the limbs together, and to seek the other sources of heat, and hunger and thirst to take food or drink, and to do nothing else? Instinct in general is, accordingly, well described by Broussais as arising always from "sensations which solicit a living being to execute involuntarily, and often unconsciously, certain acts

Digitized by Google

necessary for its welfare." Thus, not only the taking of food when hungry, but the selection by every kind of animal of its own proper aliment, the hoarding up by some tribes of a store, in apparent anticipation of a time of need, the depositing of their eggs in appropriate places, the choosing by each of its proper habitat, and the construction by many of fit places of abode, all appear to indicate nothing more than blind impulses arising from sensations, themselves the result of specific irritations in certain parts of the body. The experiment of Galen with the young kid, which selected milk, seen for the first time, from numerous other kinds of aliment placed before it, is well known; and that in all such cases, the selection is determined by an uneasy sensation, which one particular aliment is best calculated to remove, and which is different in every animal, according to its particular organization, is as unquestionable as that, in certain states of the human stomach, an appetite for acid, and in others for alkaline substances, is experienced, without, however, any thing like a reasonable conviction of their efficacy. In like manner, the ant hoards up its grain, and the bee its honey, not from any reasonable persuasion that they shall in future stand in need of such supplies, but because their organization is such, that omitting to do so would be felt by them as a natural appetite ungratified. It is as actuated by the same impulse, that moths and butterflies lay their eggs always in situations where the young caterpillar, on being hatched, can

Digitized by Google

at once procure substances adapted for its nourishment. They think nothing of this; but they lay their eggs in such situations, because they are prompted to do so by an uneasy sensation, excited probably by certain odours, as dogs and other animals are stimulated to certain excrctions under similar circumstances. The instance, also, most commonly brought forward of instinctive action,—that of a young duckling, even though hatched and reared by a hen, running into the water the first time it comes near it, seems to be explicable on precisely the same principle as the others.* It evidently does so, as a means of obviating the uneasy sensation arising from the want of gratification of one of its natural appetites, which could not be indulged while on dry land; and it is from a similar cause that every animal at once betakes itself to that element, and that situation, to which its organization is adapted, and an exclusion from which is —like confinement and restraint of every kind—felt to be a positive evil. Thus the eagle inhabits the rocks, the heron the shores, the partridge the plains, and the ptarmigan the loftiest peak of the mountains; the snipe wades in the marshes, the

* "Take," says Galen, "three eggs, one of an eagle, another of a goose, and a third of a viper, and place them favourably for hatching. When the shells are broken, the eagle and gosling will attempt to fly, while the young of the viper will coil and twist along the ground. If the experiment be protracted to a later period, the eagle will soar to the highest regions of the air, the goose will betake itself to the marshy pool, and the viper will bury itself in the ground."

Digitized by Google

lark frequents the furrows, the woodpecker creeps around the trees, and the shrill cry of the landrail issues from among the long grass of the dank meadows; the martin, too, builds in our windows, and the sparrow in our roofs, not because they have any precise object in so doing,—however important might be the object of the great Creator in disposing them to do so,—but because their organization is such, that any other situation would be to them "weary, stale, flat and unprofitable." Among other instances of instinctive actions commonly brought forward, are those from which result the beautiful fabrics so frequently constructed by some of the lower animals, and so admirably adapted each to the end which it appears to have been intended to serve. Of this nature are the shell of the snail, the web of the spider, the cocoon of the silk-worm, the comb of the bee, the nests of birds, the huts of beavers, and innumerable others, which display at once the most delicate mechanism, and apparently the most admirable foresight. Concerning the foresight, however, we have already said enough, in speaking of the hoarding up of grain by the ant, and of honey by the bee; and concerning the mechanism, we shall find little grounds, on this score, for attributing to the agent in question any thing more than the blind impulse above alluded to, when we remember that fabrics infinitely more subtle, and furnishing infinitely better illustrations of the adaptation of means to an end, are frequently the

Digitized by Google

work of agents to which we concede neither thought nor sensation, but only irritation.*

* Among the most singular of these, is that faculty possessed by animals by which not only the *particles* of each individual tissue and organ of which their bodies are composed are continually undergoing a change, by the processes of absorption and deposition, and the whole body in this manner kept, as it were, in a state of freshness; but *whole tissues and organs*, if accidentally removed, frequently entirely regenerated. This occurrence, however, is much less frequent in man, and the more perfect animals, than in the less advanced forms of organized beings. In plants the power of reproducing parts which have been removed is almost unlimited, and in many of the avertebrate animals it is very remarkable. Thus, the star-fish (*Asterias*), the sea-anemone (*Actinia*), and the cuttle (*Sepia*), are capable of reproducing their rays and tentacula;* and crabs, lobsters, and cray-fish (*Cancer*), have the same power with respect to their claws;† the snail (*Limax*) can even reproduce its head with all its natural appendages;‡ the earth-worm (*Lumbricus terrestris*), and the water-worm (*L. variegatus*), can regenerate either extremity of the body;§ and the fresh-water polypus (*Hydra viridis*), if cut into numerous pieces, is capable of becoming, by the renewal in each piece of all deficient parts, as many perfect animals.‖ Nor is this faculty confined to the avertebrate tribes, since many vertebrate animals also, and in particular the reptiles, possess it to a very considerable degree, numerous experiments having abundantly proved that the frog,

* A Trembley, Mémoires pour servir à l'histoire d'un genre de Polypes d'eau douce. C. Bonnet, Considerations sur les Corps Organisés. Reaumur, Mémoires pour servir à l'histoire des Insects, &c.

† Reaumur sur les diverses reproductions qui se font dans les ecrevises, les omards, &c. Mem. de l'Acad. Roy. des Sciences.

‡ Spallanzani, Précis d'un ouvrage sur les reproductions Animales. Bonnet's Experiments in Spallanzani's Tracts, &c.

§ Reaumur. Bonnet. Spallanzani. J. G. Dalzell. Observations on the Planariæ, &c.

‖ Trembley, *ut supra*.

Instinctive actions, then, appear to be directly connected with sensation, in the same way as certain organic actions are with irritability, and rational actions with thought. They seem to stand, as it were, midway between the two latter, with one or the other of which it is remarkable that they have been almost constantly confounded. We have already had occasion to remark, that, by some philosophers, all instinctive action has been attributed to merely an exquisite kind of mechanism, such as may perhaps be brought to explain the actions resulting from mere irritation, but is quite inapplicable to such as are instinctive; while, on the other hand, they have been, by many others, referred not only to thought, but to the most sublime degree of

the water newt,* and the lizard,† for example, are capable of reproducing their eyes, lower jaw, tail, and extremities. In the hot-blooded animals this faculty of reproduction is considerably less striking, and the instances of renewal of removed organs in birds and mammals are comparatively few and unimportant. Such, however, have occasionally occurred, and even in man examples of the reproduction of whole organs are not wanting, as in the case of the nails‡ and other parts;§ after the removal of the cervix uteri also, a new os tincæ, more or less perfectly formed, is frequently met with, and the records of surgery show that after the excision of a joint, a new joint, more or less perfect, has been observed.

* Spallanzani's Experiments on the Tail of the Tadpole. Précis, &c. Experiments on the reproduction of the extremities of the frog and toad, in Troja de Ossium Regeneratione.

† Bonnet and Blumenbach. Experiments on the eyes of lizards. Rudolphi on the tail of the lizard, &c.

‡ London Med. and Phys. Journ. 1817.

§ Edinb. Med. and Phys. Essays.

Digitized by Google

intelligence of which we can form any conception. Instinctive motions are prompted by a monitor, the voice of which is infallible, and they tend, with absolute certainty, to the attainment of their object; and it is on this account that they are not susceptible of any ulterior improvement.* Hence has arisen the notion that they spring from a kind of inspiration—from the still small voice of the Almighty, which at once excites and directs them; and hence, upon the presumption that instinct was the impelling principle of brutes, and reason was of man, and from a comparison of the deceitfulness of the latter, with the total exemption from error of the former, arose the maxim so common with many writers, that *Deus est anima brutorum.*

"Animals in their generation," says Addison, "are wiser than the sons of Men, but their wisdom is confined to a few particulars, and lies in a very narrow compass;" and Cuvier has lately described instinct as identical with innate ideas, which we shall presently see have been identified with God

* We have sometimes heard it objected, that instinct cannot be perfect and undeviating, because some insects are said to mistake certain stinking plants for putrescent substances, and deposit their eggs upon them. But it is not less likely that insects, prompted by instinct, should deposit their eggs in substances susceptible of so rapid a decomposition as may afford a congenial nidus to the young animal, than that they should do so on substances already undergoing such decomposition. Both the Phallus and Agaricus, the plants alluded to, possess not only a putrescent odour, but are very rapidly reduced to that state.

Digitized by Google

himself.* But, as the notion of animals being mere machines, in as far as their instinctive operations are concerned—however true it may be with respect to such of their motions as depend on irritation—tends to degrade instinct below its proper rank, so the presumption, that "'tis the Divinity which stirs within them," and directly actuates these operations which are thus represented as springing, not only from mind, but from the most sublime mode of this faculty, tends equally to elevate it above its proper place. The very fact of the instinctive impulse being more unerring, and instinctive operations more precise, and more exquisite in their results than those of human reason, seems inimical to the conclusion, that they are the effects of the immediate influence of an intelligence superior to this; since, while they excel those of human reason, they still fall short of those of mere irritation, as these again often do of those of mere chemical or mechanical attraction and repulsion. The fact appears to be, that the greater number of the movements of matter have in reality nothing to do with mind as directly concerned in producing them. "They are," as remarked by Sir Charles Bell, "the mere consequences of events immediately anteced-

* The instinct of animals has been called by Sir Isaac Newton, "the wisdom and skill of a powerful ever-living Agent;" by Addison, "an immediate impression from the First Mover;" by Hartley, "a kind of inspiration;" by Hancock, "the Divine energy;" by Mason Good, "the Divinity that stirs within them;" and by Kirby, "the interagent of the Deity."

Digitized by Google

ing, and have not the least connection with a previous purpose or mental judgments in the beings or things in which they are displayed." They appear to be, indeed, as we have just implied, frequently the more perfect the lower is the rank of the agent whence they immediately spring, those resulting from merely chemical and mechanical attraction and repulsion being the most so, next those of irritation, afterwards those from sensation, and, lastly, those from thought; and why any new *Deus in fabula* should be put in requisition to account for the proper instinctive motions, when we require no such agent in accounting for any of the rest, is altogether inexplicable. Far be it from us to appear to question for a moment that the Deity presides over all the movements of all forms of matter, inanimate and animate; but he does so, not directly, but through the medium of certain definite laws, imposed by himself, and with the uniform operations of which we have no reason to believe he even interferes. The motions which determine the formation of a crystal, the development of a flower, the construction of a cob-web, and the manufacture of a watch, all equally proceed from the fiat of the Almighty; but his immediate instruments are respectively the laws of attraction and repulsion, of irritation, of sensation, and of thought; and it is with these laws alone that we have any thing to do in philosophy.*

* That the reader may not suppose principles such as these to argue the inutility and the hopelessness of prayer, we shall

Digitized by Google

As the primary seat of irritability seems to be, at least in animals, the system of nerves called ganglions, so that of sensibility appears to be, not—

lay before him the opinions of Dr Chalmers, and of Mr Taylor, the author of the Natural History of Enthusiasm, upon this most important subject; it has been admirably discussed by the Reverend Divine in his treatise on the Doctrine of a Special Providence and the Efficacy of Prayer (*Chalmers' Works*, ii. 358); and to this work we must refer the reader for detailed arguments to shew that the answer to prayer may be effectively given without any infringement on the known regularities of nature. These regularities consist in the invariableness of certain successions, each term of which is the consequent of the one that went before it, and the antecedent of the one that comes after it. Grant that the contiguous links of any one chain, as far upwards as we are able to trace them, follow each other in precisely the same order, it should be recollected of the chief terrestrial processes which are going on around us, that the chain does not terminate at the point where our observation terminates—that, somewhere along the ascent of our investigation, the mechanism ceases to be palpable, and begins to be obscure, till at length it is shrouded, as if by an impenetrable veil, from our notice altogether; and that although we can trace the steps of a casual progression a certain way back, it loses itself at last among the recondite places of the mechanism. Now, it signifies not to the final result, whether the answer to prayer be given by a responsive touch from the finger of the Almighty at a higher or lower place in the progression, as a change upon any of the terms, wherever it may be situated, will have a controlling efficacy on all the succeeding ones. Let the change, then, be effected far enough back, and there will be the alteration of a sequence no doubt, but without violence to any ascertained law—because a sequence beyond the reach of all our philosophy. Prayer may obtain its fulfilment without any visible reversal of the constancies of nature—provided that its first effect is upon some la-

Digitized by Google

as was formerly supposed to be the case—the brain, but the posterior portion of the spinal chord. The appearance of a spinal chord, as we rise in the scale

tent and interior spring of the mechanism, and not among its palpable evolutions. Let but the touch of communication between the Deity and His works, when He goes forth to meet the desire of any of his creatures, be behind or underneath that surface which marks and measures off the farthest verge of man's possible discovery, and then there may be many a special request which receives as special an accomplishment, yet without disturbance to those wonted successions which neither the eye of man, nor his nicest instruments of observation, shall enable him to ascertain. Such is the opinion of Dr Chalmers (p. 336); Mr Taylor advances an hypothesis which has peculiar recommendations. His conception is, that the history of nature and of society is made up of innumerable progressions, in lines which perpetually cross each other, and which, at their point of intersection, receive a new direction, in virtue of the lateral impulse that has come upon them. When an individual receives an answer to his prayer, the interposition might be made, not in the line which he himself is describing, but in one of those which are to meet him in his path; and at a point, therefore, where, even though the visible constancy of nature should have been violated, yet, as being at the time beyond the sphere of his observation, is a violation not visible to him. The reader will observe the advantage this hypothesis has over that of Dr Chalmers; for, as he himself says, "in the one the interposition, as being made at an anterior place in the scale of causation, might require at times to be made, not in answer to prayer, but in anticipation of it; while in the other, the interposition if made, at however little a way from the point of junction, might be made both after prayer and beyond the direct cognizance of the supplicant."

That God is the "hearer and the answerer of prayer," and "a very present help in the time of trouble," every Christian must feel to be true; but how he is so, without any infringe

Digitized by Google

of animal creation, precedes that of a brain exactly in the ratio that sensation precedes reason; and, in the human fetus and infant, the former is developed before the latter precisely in the same ratio.

That the brain, moreover, is not the sensorium, seems to be proved by the facts, that sensation is impeded only when the base of the brain—the part by which it immediately communicates with the spinal chord—is injured; that if only one side of the brain have been injured, the impediment to sensation is experienced only, or chiefly, on the opposite side of the body, which can be attributed only to the crossing of the fibres from right to left and *vice versa*, found to take place about the summit of the spinal chord; from which, therefore, and not from the brain, it may be inferred that *all* the sensific nerves immediately arise; that the impediment to sensation is, in these cases, often recoverable, which it could not have been had the injury of the brain operated otherwise than indirectly in producing it; that sensation often survives, in the

ment on the visible sequences of nature, seems, perhaps, after all, a mystery; and it may be more philosophical at once to proclaim our ignorance—at once to confess with the Psalmist, that such knowledge is too wonderful for us, too high to be attained unto, than involve ourselves in speculations absolutely beyond the reach of human faculties even in their highest and most exalted states of development; and only to be understood by Him who "measured the waters in the hollow of His hand, and meted out heaven with the span, and comprehended the dust of the earth in a measure, and weighed the mountains in scales, and the hills in a balance."

Digitized by Google

lower parts of the body, a total separation of the brain, effected either experimentally or by disease, or accident, from that part of the spinal chord which sends nerves to these parts; and, lastly, that, while a lesion of the brain in general is totally unfelt, a lesion of the posterior columns of the spinal chord, or of the nerves connected with them, is attended with the most agonizing pain. Further, it is sufficiently well known that very many of the inferior tribes of animals far excel man in the acuteness of their sensations—as, among birds, the eagle, sparrow-hawk, and kite in sight, the owl in hearing, the vulture, [illegible], rook, and wood-cock in smell, and others probably in some of the other senses—which could not have happened had the brain, in the relative size of which man so far surpasses all other animals, been the sensorium, but which is easily explained by the admission, that the immediate seat of sensibility is the spinal chord, in the relative size of which man falls so far short of brutes in general. And do we not tacitly allow that such is the case, by continually using the expression of sensual as the direct antithesis to that of intellectual; since, if the immediate seat of intellect be, as it is universally admitted, the brain, it is obvious that some other seat must be assigned for a faculty which is thus, by common consent, opposed to it?

It is, then, to the posterior columns of the spinal chord, and not as Monsieur Virey has done, to the ganglionic system of nerves that we are disposed, in animals, to refer these motions properly called instinctive.

Digitized by Google

CHAPTER IX.

THE NATURE OF THOUGHT.

The third and last faculty possessed by animals, although perhaps by still fewer than sensibility, is the FACULTY OF THINKING; and, as sensibility appears to be acted on only by irritation as its proper stimulus, so this faculty seems to be acted on, in the same capacity, only by sensation. Thought, then, is not, any more than sensation or irritation, any thing substantial; it is not an entity, but a mode of being, and consists in certain phenomena, peculiar to the higher orders of living beings, and necessarily resulting from one property of their organization—the faculty of thinking—in action. And this view of the matter we are particularly anxious of inculcating, from the persuasion that it is from the want of it that much of the difficulty commonly supposed to attend the investigation of the mental operations, has arisen. It is a prevailing impression that these operations are always isolated, and have no parallel in the animal economy; and the actions of the body and those of the mind —the business of physics and that of metaphysics—

Digitized by Google

have been generally regarded as directly contrasted with each other. We know matter, it is commonly urged, only by its properties,—extension, impenetrability, and so forth; and we know mind also only by its properties,—attention, comparison, judgment, and the like; and where two sets of properties are so decidedly dissimilar from each other, they must indicate, it is argued, different entities. Thought, then, in this view of the subject, may be attached to matter, but cannot be a mode of being of matter; since matter, in no case, it is alleged, manifests those indications, by which we recognise mind. In no *other* case, certainly; for in no other case is the organization of matter such as to be susceptible of this mode of being. But are the indications of mind, it may be asked, more distinct from those of matter in general, than the indications of sensibility—sight, hearing, smell, and so forth; or even than those of irritability—muscular contraction, secretion, absorption, and other organic actions? Certainly not; so that, if a difference in properties necessarily evinces a difference in entities, we must regard irritation and sensation, not as mere modes of being of matter proceeding from certain faculties or susceptibilities, the results of its peculiar organization, but each as a distinct entity, attached to matter in the same manner as thought is presumed to be. They all consist in perceptions of a certain character, corresponding to the susceptibility of the organ acted on, and the power acting. The muscular fibre must have perceived the sti-

Digitized by Google

mulus, whatever it were, which called it into action, or it would not have contracted; and the sensorium must have perceived the stimulus of the irritation of the eye, or it would not have seen: the seat of the faculty of thinking does nothing more than perceive the stimulus of certain sensations, and thought is the result, the consciousness of which, overwhelming as it is, is only proportioned to the extent of its proper organ,—which is naturally identified, as it were, with the individuality of the brain to which it belongs,—and the sublimity of the function which it exercises. If, then, by the word mind, we understand the faculty of thinking, it is as decidedly an attribute of one part of the corporeal system, as irritability and sensibility are of the others. But no one has regarded irritability as constituting a branch of study quite distinct from the other properties of matter in general: it is true, it is proper to organized or living matter; but it is as characteristic of this, as any chemical or mechanical property of inorganic matter,—as combustibility of phosphorus, for example, or elasticity of ivory. But irritability is certainly equally remote from the other properties of matter in general, as sensibility is from irritability, or the faculty of thinking, again, is from sensibility. There is the strictest analogy between them all; and it is an analogy which the physiologist should never lose sight of, since it is only so far as this analogy is admitted, that the operations of the mind become a legitimate object of physiological investigation.

Digitized by Google

Nor is this view of the matter in any degree inimical, as is sometimes vaguely supposed, to the purest and loftiest religion: on the contrary, it seems to be the only view which is easily reconcilable with its dictates. The hackneyed arguments against it, founded upon its supposed impiety and immoral tendency, all seem to proceed upon the erroneous assumption that the soul and the mind are identical.* But who that has watched for five

* It is a very common impression—and one very far from being confined to the uneducated—that not only is the supposed principle of Thought and the real principle of Immortality identical with each other, but also the vital principle and the sensitive principle; and all four have had applied to them the same name, as Soul, Spirit, &c. An attempt was indeed made at a semi-distinction by Aristotle, who, while he confounded together the Vital, Sensitive, and Immortal Principles, under the general name of Ψυχὴ or Εντελέχεια, still subdivided this into the Θρεπτικὴ, or simply Vital, and the Αισθητικὴ, or Sensitive and Immortal, and at the same time admitted a distinct Rational Principle under the name of Νοῦς or Φρὴν; and a similar distinction was affected by the Romans, who, while they called the Vital and Sensitive Principles collectively Anima, distinguished the Rational by the name of Animus, or Mens. Thus Juvenal—

> "Indulsit communis Conditor illis
> Tantum Animas, nobis Animum quoque," &c.

Galen again tried an arrangement somewhat different, splitting the Vital Πνευματα into two classes, under the names of proper Vital and Natural, while he packed on the contrary the Sensitive and Rational together, under the name of Animal. None of these proposed distinctions, however, were ever steadily maintained; and indeed it was impossible that they should be so, thus discordant and irreconcilable as they were. Dr Barclay indeed coolly argues that they were all unfounded;

Digitized by Google

minutes the actions of a dog—to descend no lower in the scale of animals—can be so blind as to deny that he possesses attention, comparison, judgment, reason, hope, fear, love, animosity,—all the intellectual faculties and passions, in short, in the display of which thought consists; yet who will attribute to a dog an immortal soul?

And here we are unwillingly obliged to digress; for in denying to the lower animals the possession

and that the four substances in question, real and supposed, are in fact all the same. The Immortal Principle he every where identifies with the rational, as being responsible for the backslidings of the latter; and the Rational again must be identical, he infers, on the one hand with the Sensitive, and on the other with the Vital, for "What," says he, "can it will or think without feeling, and how can sensation subsist without life?" (*On Life and Organization*, 1822, p. 495.) Upon such principles as these we might undertake to prove, on the one hand, that a surety is identical with the man for whom he is bound, and, on the other, that the second story of a tenement is identical with the first, and the third with the second, because they cannot respectively subsist independently of each other. Mr Abernethy had some time before contended against confounding perception and intelligence with mere vitality (*Mr Hunter's Theory of Life*, 1814); and Dr Pritchard rationally concludes that at least the Vital principle and the Sentient, Cogitative, and Immortal principle—all which he unfortunately regards as one and the same—"supposing for a moment that both really exist, are entirely distinct in their nature and attributes." (*On the Vital Principle*, 1829). To a similar effect, says Dr Alison, "Whatever notion we may entertain respecting the existence of a Vital principle, it has no connection with our notion respecting the Existence of Mind," &c. (*Outlines of Physiology*, 1831, p. 3.) See Fletcher, part ii. and p. 32.

Digitized by Google

of a soul, we think it necessary to state, before proceeding with our argument, that there is one passage in Scripture, with which the view we have taken may seem to be inconsistent. It is in Romans VIII. 19—23, and is as follows:—"For the earnest expectation of the creature waiteth for the manifestation of the sons of God. For the creature was made subject to vanity, not willingly, but by reason of him who hath subjected the same in hope, because the creature itself also shall be delivered from the bondage of corruption, into the glorious liberty of the children of God. For we know that the whole creation groaneth and travaileth in pain together until now; and not only they, but ourselves also, which have the first fruits of the spirit, even we ourselves groan within ourselves, waiting for the adoption, to wit, the redemption of our body." We need not inform the hierological reader that this passage has no parallel, nor of the difficulties in which it is supposed to be involved. At least three very distinct interpretations have been proposed, each claiming the support of distinguished names. By the "whole creation" some commentators understand all terrestrial created existence, animate and inanimate, making the words πασα ἡ κτισις, denote the whole creatures of God, which, as they were cursed for the sin of the first man, may, by a beautiful rhetorical image, be represented as groaning together under that curse, and earnestly wishing to be delivered from it. But such images are not unusual

Digitized by Google

in Scripture: thus the mountains and hills are said to break forth into singing, the trees to rejoice, and the fields to clap their hands: mere poetical images to express a happy state attended with joy and exultation, and as such, in common use, among profane writers. Virgil, in the same strain, says,

> "Ipsi lætitia voces ad sidera jactant
> Intonsi montes; ipsæ jam carmina rupes,
> Ipsa sonant arbusta."

Other commentators following the analogy of the בריח, limit it to the human race; while a third party make it synonymous with the new creation, viz., real Christians and true believers. If either of the last two views be correct—and it will be allowed, at least, that a very high probability attaches to any opinion supported by such names as Schleusner, Le Clarc, and Koppe—then the passage has no reference whatever to the lower animals. But even if the first be adopted, if the expression must be viewed as comprehending the brute creation, it does not, by any means, necessarily involve their immortality. It might be viewed as intimating that the lower animals are to participate in the blessings of the Millennium. But this would not imply that the *present individuals* are then to be raised up, only that the individuals *then existing* shall feel the influences of millennial peace. If we were to say that the day is coming when the population of America shall all enjoy their freedom, it would not be understood as intimating that every individual slave who now groans in bondage should

Digitized by Google

see that day, but only that all the slaves *then* in life would be set at liberty. If a similar interpretation be applied to the passage before us, all difficulty will vanish; at any rate, the view which makes all created beings to be waiting for the manifestation of the sons of God, that is for immortality, seems to us quite contradictory of Ecclesiastes iii. 21, which expressly tells us that the "spirit of the brute goeth downwards," and is at an end; while the immortal soul of man "goeth upward" to the God who gave it. The interpretation that makes man the "creature" of which St Paul speaks, seems, however, to us the most correct; and we most fully agree with Dr Macknight in his view of the subject; which, to obviate any difficulty, we here present to our readers. "In verse 21," says that learned and reverend doctor, "where it is said, that the creature itself will be liberated from the bondage of corruption, into the freedom of the glory of the children of God, and the antithesis, verse 23, not only they but ourselves also, shew that the apostle is speaking, not of the brute and inanimate creation, but of mankind, and of their earnest desire for immortality. For these reasons, and especially because, Mark xvi. 15, preach the Gospel, πασῃ ἡ κτισις, to every creature, means to every human creature, I think, πασῃ ἡ κτισις, in this verse, and ἡ κτισις, in the three preceding verses, signify mankind in general, Jews as well as Gentiles. In Col. i. 23. also, πασῃ ἡ κτισις signifies *every human creature.*" (*Macknight's Translation.*)

Digitized by Google

But to return to our argument that soul and mind are not *alter et idem*; let us adopt another, and perhaps a more pertinent illustration, because it is furnished by a certain psychological condition of the human mind itself. We have hitherto contemplated and treated the mind in its healthy, vigorous, and natural state, let us turn for a moment to the phenomena which attend its disease, decay, and, we speak advisedly, its death. Physicians owe one-half of their discoveries to a consideration of the functions of the different organs of the system, when deviating from the standard of health, when interfered with or suspended; and may not metaphysicians learn something, nay much, from investigating the operations of mind when they are disturbed by disease, whether that proceed from an abrogation of the laws by which they are governed, or from structural changes affecting the nervous system. It is surprising that this department of philosophy cannot boast of a single student. Let us then, as we have done in the case of the lower animals, watch and examine the actions, and listen to the words of a lunatic. We perceive in the former extravagance; in the latter, inconsequence and want of relation to the objects around, the matter under discussion, and even to the supposed state of the speaker's mind; and we know, from previous experience, that neither of these features belonged to the original and normal character of the individual. But although the act of thinking and the act of representing thought, or, it may happen, all the intellectual acts, be here impaired, many of the emo-

Digitized by Google

tive powers may remain in their primitive strength and stability—provocation may excite anger, kindness may elicit affection, there may even remain a strong devotional feeling; the mind may be said to be partially injured, and mutilated, or, if the expression displease, to be capable of being affected in certain modes only, or to resolve itself into certain states only. There are here obviously presented two facts, an original constitution of entireness, and secondly, a new condition in which certain qualities of the former are altogther wanting, and certain others, modified in consequence of these. Moreover, these changes are not cognisable, or are not recognised, by the mind in which they have taken place. Consciousness fails to indicate either that processes of thought are different, or that the means by which these processes are carried on are different from what they were at a particular time, or during the whole period to which memory extends; and the individual lives on persuaded of the uninterrupted continuousness of his ideas, and of the identity of his powers. What becomes, it may be questioned parenthetically, of the argument that the mind is immaterial because it is unchangeable; that while the particles of the body are so transitory as to lead to a renewal of the whole mass in the lapse of a few years, the immaterial and immutable mind remains the same, with the exception of such alterations as culture may produce on it, to-day and for ever? We shall not insist, because, from the abundance of more conclusive reasons,

Digitized by Google

there is no necessity for insisting, on the fact that this admission of alterations, being brought about by education, settles the question, and shews that the thinking principle *does* undergo change, and that of great magnitude. But here are alterations amounting to the obliteration of whole classes of faculties; here is that principle shorn of some, of one-half or two-thirds, of its most glorious attributes, and yet we are called upon to admit that it continues, while the worn out elements of the body with which it is connected, are cast off and are replaced, and, under all circumstances, invariably the same in essence and in mode of action. It is unnecessary to prosecute the inquiry; and to revert to the original investigation. We have depicted, and the picture is faithfully drawn from life, a being possessing a mutilated mind, but without any consciousness of such mutilation. Now, it would be well to know from those who contend for the identity of mind and soul, if it be the immortal soul that is here injured; if it be the spirit which has suffered obscuration; and if the individual be actually the same individual, seeing that his soul has sustained a complete transformation, and that he thinks and feels without any, or with an imperfect recollection of, or reference to, his original condition. These are difficulties, we apprehend, which it will require some ingenuity to move. But the illustration is not exhausted. If we contemplate the same individual at a more advanced period of the disease, when, in technical language, he has become fatuous,

Digitized by Google

we discover not merely that solitary powers are impaired, or that a portion of intellectual vigour is abstracted, but that the whole mind is ruined and annihilated: we find that all healthy volitions, and all eccentricities, and extravagancies, alike have disappeared; that no manifestation of mind can be elicited; that even the senses are in a state of hebetude; that we are examining a living, breathing automaton, without judgment, memory, emotion, even without sensation. Now, here is a case, and it occurs every day, where there exists no evidence of the existence of a mental process, where indeed there is demonstrable proof that all mental processes have ceased. And are we accordingly justified in holding that it is the immortal soul which has been extinguished; that our spiritual nature has ceased to exist, in consequence of some organic change in the structure or functions of the body? Those who believe that mind and soul are synonymous, that acts of judgment and states of feeling are really acts and states of soul, *must* hold some such opinion. It is true that this dark and dreadful conclusion may be made to assume a less repulsive aspect; but divested of those qualifications which sophistry may supply, it resolves itself into the plain statement that mind and soul are one, and that mind may be injured and destroyed. Surely it is more preferable to conclude, that the display of mental acts depends, at present, on certain conditions of organization, and that they may undergo changes, or suspension, while the soul is in no other degree affected

Digitized by Google

by the circumstance than is matter when it loses its rotundity, its angularity, its colour, or any other secondary quality, or, to employ another comparison, as it, itself, is in the child before the evolution of these qualities; and that it awaits, in its original essence, the day-spring of another state of existence to resume these, or put forth other powers, under such laws and conditions as may be appointed by almighty wisdom and love.

There is still another aspect in which the subject may be presented. It is afforded by certain considerations springing out of the discussion as to the emphatic "Ego," and seems to establish the distinction between mind and soul. The argument is contained in the two states, what is thought and what thinks. We judge, entering upon a chain of reasoning in which a multitude of ideas and associations are presented, in which new arrangements of thought are suggested, and so forth: now, how is it known to the individual, thus judging, that it is by him and in him that the process is carried on? Evidently by consciousness;—then, that the process is present to the mind, and that the mind knows that it is present, is a proposition on which all men are agreed. But even from this proposition, we must unavoidably infer, that the mind is something apart from its own acts; that they may be present to it or not, and yet it continues the same; that the mere states designated reflecting and feeling, are states, or qualities of something, but that they do not and cannot constitute that thing itself.

Digitized by Google

If this be correct, it follows, that besides what is generally treated as mind, these states namely, there is a more remote entity, with which these states may, or may not, be associated. Further, if such be the case, and the mind or soul preserve its identity, whether these states be present or not, the phenomena of madness are to be explained on the ground that certain of these states are not present, or are present in an imperfect manner.

The existence of a soul, attached during life to the body of responsible men, and surviving to all eternity, a divine gift to that creature alone, who, from the paramount perfection of his faculties, or as alone competent to recognise his almighty Creator, and to acknowledge the allegiance which he owed to him—we are explicitly taught to believe; but it is a belief of faith rather than of demonstration, and to be determined not so much by its susceptibility of proof, as at once by its verisimilitude, and by our confidence in the authority on which it rests. Can any one contrast—as every one does and must do—the chaotic condition of the moral world in this state of our existence, with the harmonized operations of the physical, and, knowing that they are equally directed by the same Omnipotent Hand, avoid believing that the Deity has set apart his own time for rectifying this temporary derangement, if, indeed, it may so be termed; and when, in addition to this intuitive persuasion, universal in every tribe of mankind, from the highest to the lowest,

Digitized by Google

we have the assurances of Revelation to the same effect, we have the less need to look to physical philosophy to corroborate it, or at least we should allow no power to physical philosophy to shake our conviction of its truth. The two subjects seem to be totally unconnected. "I have no hope of a future existence," says a late talented Professor of Divinity in the University of Cambridge, "except that which is grounded in the truth of Christianity." We could never have inferred the existence of an immortal soul in man from any phenomena of thought; and that the former is something essentially distinct from the latter—which is nothing, at least nothing substantial—is unquestionable. So far, then, we know what the soul is *not*—what it *is* it will be time enough to investigate when we can conceive the nature, distinct from the properties, of the least of the particles entering into the composition of one of the filaments of the down upon a blade of grass; though should we succeed in comprehending this, and much more than this, what right should we still have to presume that nothing can exist which was beyond the sphere of our comprehension? We cannot conceive, it is said, the nature of the soul, distinct from thought. God alone knows how little the most profound of us, big with the conceit of penetrating into the sublimest mysteries of his greatest works, really and truly knows of the most familiar features of the least of them; and God, it is to be hoped, will pardon, through the merits of our great Mediator, at once the rash flippancy with which the

Digitized by Google

firmest and the best persuasions of natural religion, and the most sacred doctrines of Revelation, have been sometimes braved, because they were falsely supposed to be incompatible with philosophy; and the bigoted blindness with which the most obvious deductions of philosophy have been at other times spurned, because they were falsely supposed to militate against natural religion and revelation. The nature of the soul is probable such as man, in his present state, has neither words to describe, nor faculties to understand; his efforts to do so, like those of one born blind, to conceive and describe the nature of light, are perhaps as irrational in their object, as they have hitherto been unsuccessful in their result; and, for aught we know, a sixth sense, in addition to those which he possesses for who shall say that every possible mode of sense has been in man exhausted ?—with all the new ideas which would thus be excited, and all the new symbols to which these ideas would give rise, may be necessary before it can be comprehended and expressed. We can infer only that the soul is not any thing which we have in common with, not only quadrupeds, but birds, reptiles, fishes, and even insects—that it is not, therefore, merely the faculty of thinking—and the withering and impious inference accordingly which has sometimes been drawn by confounding the condition of man with that of other animals, is totally unwarrantable.

We have insisted so much on the expediency of viewing the operations of mind merely as the result

Digitized by Google

of a material organ, for two reasons, one of which was before hinted at, namely, because the assumption, that the mental faculties are spiritual in their nature, seems calculated to interfere with the progress of the true physiology of the nervous system; and secondly, because we think the cause which that assumption is destined to serve, the cause of natural religion, is materially injured by it. The importance of right notions on such subjects to all, and the particular importance to ourselves individually, that our sentiments on this point should not be misapprehended and confounded with the opinions of those who are the enemies of true religion, will warrant a slight digression from what is strict physiology at this place.

It is not because we join with those, who reprobate the reasoning from final causes altogether in philosophy, that we object to the assumption of the spiritual nature of mind; but because, while we contend, that this doctrine is, on all occasions, in physiology, to be used with the utmost caution, it seems to be particularly liable to lead into error and retard the progress of knowledge, in regard to the functions of the nervous system. In this department of physiology we generally, but absurdly, set out with ideas of spirit drawn from reflection on the subjects of our own consciousness, that is, from the consciousness of the only animal which possesses it in the most extended range; and with a determination to see nothing that shall interfere with our preconceived notions of the adaptation of this spirit-

Digitized by Google

ual nature to immortality, attempt to apply our principles to the rest of the animal kingdom. Is it surprising, then, that so little progress has been made in the metaphysics, if we may so term it, of the lower animals, when such a mode only of cultivating it has been usually practised? This is indeed, as Lord Brougham remarks in his Discourse on Natural Theology, "The great abuse of the doctrines of final causes; and the more to be dreaded because of the religious feelings which are apt to mix themselves with such speculations, and to consecrate error." This is a limitation, we should observe, made in an eloquent argument in favour of the use of final causes in philosophy, from the general scope of which we are very far from dissenting. The true method, certainly, of cultivating the physiology of the nervous system, is to examine its phenomena where they are least numerous, and the organs concerned least complex; and thus to proceed onwards, while the development of function is traced, as new structure is again and again involved. We may discover the source of most of the systems of instinct in the opposite mode of investigating this subject, that in which the properties ascertained as appertaining to man being received as the groundwork on which was to be reared the whole system of nervous function throughout the animal kingdom. Cogito, ergo sum, said the Cartesian, (to which as a mere part of human metaphysics, no objection arises); but setting out to the investigation of the animal nature, he came to the very absurd con-

Digitized by Google

clusion, that all the inferior animals were mere automata, machines wound up to go through a certain amount of evolutions before their machinery ran down, being altogether void of consciousness. Buffon's inclination and aversion as the springs of action in animals, are of the same character. The same kind of investigation led Helvetius and Darwin to their theory of reasoning being the source of all animal phenomena; in which, as instinct plainly excels reason in the perfection of its acts, they have somewhat overstepped the model on which their hypothesis is constructed.* And the same may be said of many such speculations.

But, while this mode of considering mind is obviously adverse to the progress of physiology, we affirm that it is also injurious to the cause of natural religion, which it is intended to serve. Our hopes of immortality, we remarked before, rest, in our opinion, exclusively on Revelation. Perhaps a probability of a future state of existence is afforded by the light of nature; but this simply illustrative of the word of God, which must altogether form the ground-work of our faith, as we have elsewhere observed, and now hope to prove. As it appears

* Lord Brougham observes, at page 75 of his Discourse on Natural Theology, "that the operations of pure instinct have never been supposed by any one to result from reasoning." Pythagoras and Plato, however, among the ancients; and Helvetius, Condillac, Smellie, Hill, Hume, and Darwin, among the moderns, have, with various modifications, absolutely identified instinct with reason.

Digitized by Google

to us, no part of any probability of a future state arises from the consideration of the actual nature or properties of mind. It should be viewed as existing altogether on an independent footing; and the argument for it should run, not as a part of physiology, but as a branch of natural theology seeking light from it, as well as from every other science.

Lord Brougham is the latest, as he is the most distinguished writer, who has attempted to prove an hereafter independently of Revelation. He has devoted two most eloquent sections, and four very erudite notes, of his Discourse upon Natural Theology, to this subject; and as, when we reply to him, we go at once to the "head and front of the offending," we shall proceed to analyze, and, we hope, confute, opinions which we feel to be founded in error, and likely to lead, both on account of the great beauty of the language in which they are couched, and the high name and character of their propagator, to very serious results. The portions of the work to which we particularly allude are sections iii. and v.

The first of these commences with a very sweeping charge against Paley and other writers upon natural theology, to the effect that, as they avoided bringing proofs of design and a designer, from the structure, habits, and operations of mind, they are either to be accused of carelessness, or branded with a tendency to materialism. "There cannot be a doubt," says his Lordship, "that this extraor-

Digitized by Google

dinary omission had its origin in the doubts which men are prone to entertain of the mind's existence independent of matter. The eminent persons above named were not materialists, that is to say, if you had asked them the question, they would have answered in the negative; nay, they would have gone further, and asserted their belief in the separate existence of the soul independent of body. But they never felt this as strongly as they were persuaded of the natural world's existence. Their habits of thinking led them to consider matter as the only certain existence—as that which composed the universe—as alone forming the subject of our contemplations—as furnishing the only materials for our inquiries, whether respecting structure, or habits and operations. They had no firm, definite, abiding, precise idea of any other existence respecting which they could reason and speculate. They saw and they felt external objects; they could examine the lenses of the eye, the valves of the veins and arteries, the ligaments and the sockets of the joints, the bones and the drum of the ear; but, though they now and then made mention of the mind, and, when forced to the point, would acknowledge proofs of design in it, they never were fully and intimately persuaded of its separate existence. They thought of it and of matter very differently; they gave *its* structure, and *its* habits, and *its* operations no place in their inquiries; their contemplations never rested upon it with any steadiness; and, indeed, scarcely ever glanced upon it at all. That

Digitized by Google

this is a very great omission, proceeding, if not from mere carelessness, from a grievous fallacy, there can be no doubt whatever."

As to carelessness being the cause of this omission, that is quite out of the question, and not for a moment to be entertained; and we are inclined to think that circumstances widely different from those hinted at, actuated Ray, Derham, and Paley, when they avoided, in their several works, to treat of the phenomena of mind as illustrative of design and its consequences. It is probable that they never were, as Lord Brougham insinuates, fully persuaded of the existence of the human faculty of thinking independent of matter, for it has no such existence; but the truth would seem to be, that, seeing through a glass darkly, they were unwilling to add to the dim obscure; and that, in such a position, they acted judiciously in omitting the subject altogether, is quite evident when we study the very unsatisfactory conclusion drawn even by one possessed of the gigantic mental powers of Lord Brougham. Nay, Paley himself has given as his reason for omitting the subject the uncertainty of the speculation. He says, " The existence and character of the Deity is, on every view, the most interesting of all human speculations. In none, however, is it more so than as it facilitates the belief of the fundamental articles of Revelation. It is a step to have it proved, that there must be something in the world more than we can see. It is a farther step to know that, among the invisible things of na-

Digitized by Google

ture, there must be an intelligent mind concerned in its production, order, and support. These points being assured to us by Natural Theology, we may well leave to Revelation the disclosure of many particulars which our researches cannot reach, as respecting either the nature of this Being as the original cause of all things, or his character and designs as a moral governor; and, not only so, but the more full confirmation of other particulars, of which, although they do not lie beyond our reasonings and our probabilities, the certainty is by no means equal to the importance."

Lord Brougham states, that "the evidence for the existence of mind is to the full as complete as that upon which we believe in the existence of matter. Indeed it is more certain, and more irrefragable. The consciousness of existence, the perpetual sense that we are thinking, and that we are performing the operation quite independently of all material objects, proves to us the existence of a being different from our bodies with a degree of certainty higher than any we can have for the existence of those bodies themselves, or of any other part of the material world." Of the operations of the mind we do indeed possess the evidence of consciousness, the highest evidence of which, as intelligent beings, we are capable of attaining; and, though that evidence in itself is not, as is assumed in the above passage, of higher authority than the evidence of sense, it may be conceded to his Lordship, in the mean time, that it is at least less liable to some

Digitized by Google

kinds of fallacy. Yet what does this admission avail to his argument? The evidence declares nothing, but the certainty of the performance of this or that mental operation at such or such a time; it suggests nothing as to the existence of the operating agent separately from the body. It proves to us beyond the possibility of doubt, that by turns we remember, imagine, judge, fall under emotion or passion; or become actuated by desire; but no concomitant belief of the distinct nature of the being that is so affected necessarily arises. It is true we feel convinced that stocks and stones never become affected in the same manner—but that is a judgment formed upon our experience—upon the repeated proofs furnished by our senses that no such thing ever occurs in regard to them. But, so far are we from feeling any original internal conviction of the distinction of the sentient, intelligent, or moral part of our nature from the body itself, that we cannot help assigning, by the very constitution of our nature, a material local seat to our separate mental and moral affections. The natural language of man lays open to us his original impression, freed from the fallacies in which they are apt to be involved by philosophical speculations. All languages make the seat of the intellect the head, while they place that of the affections in the heart or viscera. In this there is sufficient proof that the consciousness of mental operations is not attended with any belief in the separate existence of an immaterial agent concerned in the production of them. The

Digitized by Google

distinction of our human nature into mind and body is a generalization of philosophy—it is not, we repeat, an idea necessarily arising out of the mere exercise of our mental faculties; and, as a generalization of philosophy, it must be tried by the ordinary tests and ordeals to which such conclusions are amenable. The idea of a separate mental agent stands on a very different footing from our belief in the existence of an external world. It is the evidence of the operation of the faculties called mental, not their independent nature, which rests on the same irrefragable authority as our belief in an external world. The operation of the senses by which we become acquainted with all that is without us, is attended, by the very constitution of our nature, with an irresistible belief in the reality of what they represent to us, and in the *outness* or separate existence of the objects from which the several impressions conveyed by them emanate. Nor is there a grosser error to be met with in all the vagaries of pseudo-philosophy than that on which Pyrrhonism rests, namely, the assumption that man has one set of faculties for the ordinary pursuits of life, and another for the cultivation of philosophy. Philosophy is essentially human. The same faculties—the same powers of reasoning—the same principles of belief which govern the savage in his simple course of life, and the civilized citizen in the acts of industry, are those, and those alone, which the philosopher must make use of in his science. For science essentially is the search, not after the laws which

Digitized by Google

may, by possibility, govern nature, but after the laws according to which man, by the necessity of his mental constitution, must see nature. To doubt, then, the existence of an external world, is just as great an error in philosophy as it would be in the common transactions of life. But, to place the evidence of consciousness on a much higher footing than the evidence of sense, as Lord Brougham has done in the above passage, is planting the first step to Pyrrhonism—but, in this instance, it may be regarded as an inadvertent hyperbole of rhetoric rather than as a logical error.

But to leave this point alone, let us consider how far the distinction of our human nature into body and mind, as a generalization of philosophy, will bear examination. The very attempt to find a name for the intelligent and moral part of man, shews how little he has been made capable of forming ideas unconnected with matter. The names which have been contrived to denote this supposed separate part of man's nature, are drawn from attenuated forms of matter: this the word taken from the *ανεμος* of the Greeks, and the *spiritus* of the Latins, plainly enough attest. We have here, then, a sort of struggle against the original impressions of our nature, in the very first steps of this generalization. But suppose that, by contrasting the operations of thought, feeling, passion, with the phenomena of bodies altogether inanimate, as the components of the mineral kingdom, instead of comparing them with the other acts performed by

Digitized by Google

living bodies, as secretion, nutrition, absorption, we have persuaded ourselves of the existence, in connection with the human body, of a separate immaterial agent by which all mental acts are performed, and which we conceive to be capable of a continued being after the body has returned to its original terrestrial elements; how does this belief fare when we bethink ourselves of looking to the condition of the other tribes of beings which participate life like ourselves? Philosophy strives in vain to draw a line of demarcation between man and other animals in this respect. In the lowest animals which exhibit a consciousness of external impressions, there is already found all that is essential to the idea of mind. Suppose this consciousness to be but momentary, to awake to the passing impression, and to be extinguished for ever as soon as that impression has ceased, as is perhaps the case in some of the zoophyta, still this is not merely the rudiment, but the actual essence of a mental operation. The consciousness of the impression made by light, or heat, or the presence of aliment in contact with its tentacula in a polype, is as much a mental operation as that thinking independently of all material objects in man, which Lord Brougham says proves "the existence of a being different from our bodies, with a degree of certainty higher than any we can have for the existence of those bodies, or of any other part of the external world."

This gives but a poor confirmation of the conclusion somewhat too hastily drawn from the con-

Digitized by Google

sideration of man's own little world of thought, to the exclusion of the rest of the animal kingdom. Had we discovered in the polype evidence of the existence of a separate agent on which its consciousness depends; that is, of an agent different from that organized frame by which the phenomena of life are sustained (and organized it is, however simply), then might we have justly inferred, that a similar agent exists throughout the numerous gradations of animal life up to man, in him to attain a development infinitely surpassing its state in any of the tribes below him. But, instead of being able to make such a discovery, our utmost efforts enable us only to detect a system of material parts more and more developed as we ascend in the scale of animals, in a proportion corresponding to the degree in which each animal becomes capable of higher mental operations. Yet, if we have persuaded ourselves of the existence of such a thinking principle, separate from the body in man, why do we not extend the conclusion to the rest of the animal kingdom, or at least to all in which consciousness is discoverable? The functions of secretion, absorption, nutrition, are in the higher animals exactly of the same character as in man; and from these there is a gradation downwards, corresponding to the decline in the general activity of living action; why, then, should we deny a corresponding similarity of the thinking agent to these animals? Why should not consciousness be uniformly the property of the same spiritual principle?

Digitized by Google

Here, however, is the Gordian knot—this conclusion is incompatible with all that we observe of man—with all that we observe of the tribes of animals below him. It is a conclusion to which our reason and our feelings are alike repugnant. And, while such obstacles remain in the way of this conclusion, it will be vain to seek an argument in favour of the existence of mind separately from the body, from any consideration of its mere sentient or thinking properties.

The whole tenor of Lord Brougham's third section is to prove, that the phenomena of mind are more demonstrative of design and a designer than the phenomena of matter. But, wonderful and incomprehensible as attention, memory, and the like are, and all-convincing as they must be of the existence of a wise and a great God, the extent of whose attributes we cannot conceive; they are not more so than any other function of the body, such as secretion and absorption; we understand both, simply by their effects, and we see both invariably associated with definite forms of matter; but, with regard to the final cause of the operation of either, that alone rests with the will of God. Both are admirably adapted to the wants and necessities of the animals in which they are displayed,—both proclaim the Almighty, but the one not less powerfully than the other.

The fifth section of Lord Brougham's work is devoted to the moral or ethical branch of Natural Theology; and the psychological argument, or evi-

Digitized by Google

dence of the Deity's design drawn from the nature of the mind, opens with the grave assertion, that "the immateriality of the soul,"—that is the mind, for Lord Brougham uses the terms synonymously, "is the foundation of all doctrines relating to its future state." Now, as it appears to us, the soul is something, not material, indeed, but substantial, a divine boon to the highest alone of God's creatures, and responsible for all the actions of the mind, but as totally distinct from it as one thing can be from another, or rather as something is from nothing; and we think it is much to be regretted that this distinction, which embraces the only philosophical view of the nature of mind, should ever have been lost sight of. It is altogether from this circumstance that many men have gained for themselves the title of philosophers, at the expense of one which should have been far dearer to them. We shall shortly reply to Lord Brougham's arguments to prove the immateriality of mind; but, in the mean time, we cannot at all see how such a faith is necessary to salvation, or how the light in which we may happen to view an abstruse and metaphysical proposition, should in the least interfere with our prospects of immortality. Lord Brougham's arguments are quite inadequate to prove the immateriality of mind, and besides, they go to prove more than his Lordship contemplated, namely, that the functions of every other organ in the body are immaterial likewise. But the argument is altogether useless, as the Christian believes that the

Digitized by Google

whole body is destined for immortal life;—our "mortal part shall put on immortality." The God who at first formed man, as we see him in all his majesty and intellectual splendour, from the dust of the earth, and, after a brief career, redissolves him into a few pristine elements, is able, in His own time, to reconstruct his work. The "*how*" we know not, but the "*wherefore*" is in Scripture revealed to us.

Lord Brougham proceeds to "the strongest of all arguments, both for the separate existence of mind and for its surviving the body;" these, although "drawn from the strictest induction of facts," are futile in the extreme, and quite overstep their march, in proving, according to the conclusions drawn from them by his Lordship, much more than he could contemplate; they prove too much. "The body," says his Lordship, and so does the physiologist, "is constantly undergoing change in all its parts. Probably no person at the age of twenty has one single particle in any part of his body which he had at ten; and still less does any portion of the body he was born with continue to exist in or with him. All that he before had has now entered into new combinations, forming part of other men, or of animals, or of vegetable or mineral substances, exactly as the body he now has will afterwards be resolved into new combinations after his death. Yet the mind continues one and the same, 'without change or shadow of turning.' None of its parts can be resolved; for it is one and single, and

Digitized by Google

it remains unchanged by the changes of the body. The argument would be quite as strong though the change undergone by the body were admitted not to be so complete, and though some small portion of its harder parts were supposed to continue with us through life."

"But observe," continues his Lordship, "how strong the inferences arising from these facts are, both to prove that the existence of the mind is entirely independent of the existence of the body, and to shew the probability of its surviving! If the mind continues the same while all or nearly all the body is changed, it follows that the existence of the mind depends not in the least degree upon the existence of the body; for it has already survived a total change of, or, in common use of the words, an entire destruction of that body."

If such an argument could for a moment be held good, every other function of the body, in the spirit of Lord Brougham's deductions,—and we have already shewn that there are many more functions than that of thought,—must be conceived to be a distinct, immaterial, and immortal entity. The organ of mind undergoes a constant change, but its function remains the same, therefore that function is independent of the existence of the organ, and will survive it to all eternity;—so says Lord Brougham: and, from a parity of reasoning, it must follow that every other function, the nutritive, the reproductive, and the relative, are in like manner independent of their several organs, which they will survive to the

Digitized by Google

end of time. What are the kind of existences reserved for these entities in a future state of existence, Lord Brougham is profoundly silent; as silent as he declares Revelation to be concerning the soul under similar circumstances. The doctrine, however, as taught by Lord Brougham, is but a return to the very ancient one, which assigns the peculiarities of the actions of the different organs of the body to their being the residence of several immaterial agents. The Pastophori first alluded to these, as genii, or demons, or decans of the air; and their pupils of Greece believed them to preside, under the controul of a great master spirit, over the functions of the several organs of the body. By Hippocrates and Galen, these were termed Δυνάμεις, and were considered to reside one or more in each organ, in subserviency to the grand Ενόρμων, or Πνεῦμα; and to be the immediate cause of the peculiar function which it performed. Thus, according to Galen, the heart was the residence of three Δυνάμεις, the δύναμις διαστελλομενη, περιστελλομενη, and συστελλομενη, or those by which it attracted the blood from the lungs, retained it for an instant, and propelled it through the body. The same thing was understood by Van Helmont under the name of *Archæii insiti*, the number of which almost equalled the organs of the body, though all were held in subordination by one sovereign Archæus, corresponding to the πνεῦμα, already mentioned, and supposed to hold his court in the stomach. Harvey also admits in each organ a *sensus proprius*,

Digitized by Google

subject to the general *anima* by which the whole body was actuated; and Glisson speaks of each organ as possessed of a "*spiritus regens* qui aliud in jecora, aliud in liene, aliud in pancreati, aliud in ventriculo et intestinis operatur."* The subject of these *imperia in imperio* has been prosecuted in more modern times by Borden and Bichât; as in the present day it evidently is by Lord Brougham; and we have ourselves applied the doctrine, with, of course, some modifications, to the explanation of the action of medicine in the removal of disease. (*Med. Quart. Rev.* 1834.) Thus, then, modern authors, as remarked by Dr Barclay, "instead of advancing any thing new, as they probably supposed, have only revived one of the most rude and antiquated notions in all physiology."

This argument, then, is insufficient to prove the immateriality of mind; but, strange to say, it is chiefly upon the same basis, and wholly independent of revelation, that an attempt is made to found the doctrine of the immortality of the soul. Alluding to the constant change the body undergoes, Lord Brougham says this fact proves the entire independence of the existence of mind of that of the body; and also "the immortality of the soul, as

* It was in ridicule of this that Dean Swift represents the action of a smoke-jack as depending on a meat-roasting power, and that of a fiddle on a time-playing power; and, in the same spirit, Molière makes his candidate for a physician's diploma reply to the question, Quapropter opium facit dormire? Quia habet vim dormitivam.

Digitized by Google

rigorously as 'if one were to rise from the dead.'" As additional evidence, however, he brings forward the attributes of God; the fact that no tribe is so dark and barbarous as to be without some kind of worship, and some belief in a future state; and, lastly, the analogies presented by nature. We hope we have already shewn the first argument to be totally inadequate to bring us to the belief of the immateriality of mind, much less to the immortality of the soul; and we think we can shew that neither the attributes of God, the universality of the belief, nor the analogies presented by nature, afford any proof, however illustrative they may be, of the doctrine of a future state.

By the attributes of God are generally understood his eternity and immutability; his omnipresence, omniscience, omnipotence, and independence; his benevolence; his justice; his truth and his mercy. We cannot conceive how any of these can be brought forward to prove an after life; indeed Lord Brougham himself only devotes a few lines to the benevolence of God, and even that in conjunction with the feelings and wishes of the human mind. The attributes of God as merely displayed in the creation, would never lead us to even the hope of immortality; nay, he who penetrates deepest into the secrets of nature, even armed with the immensity of mental energies displayed by Lord Brougham, bringing down knowledge from the heavens, digging it from the depths of the earth, and searching for it through the vastness of the

Digitized by Google

ocean, extracting it from minerals and the wonders of vegetables, and the birds, and the beasts, and the meanest insects, will only multiply proofs that "verily there is a God," who made and rules the universe. The character he will obtain of God is not that by which the Christian knows him; he will discover a fearful blight upon the face of nature, and marks of imperfection and disorder will every where perplex him; in the intellectual world he will see error and ignorance, fatuity and folly; and in the moral world passions, prejudices, selfishness, wars, cruelties, and innumerable crimes; in external nature he will find the air, and the earth, and the sea teeming with agents of apparent evil—whirlwinds and tempests, mildew and drought, with famine and pestilence in their train, carrying desolation abroad, while decay and death fill the world with mourning. And how will man himself be viewed? While other animals are formed with admirable skill to fulfil the end of their existence, and to be happy up to the extent of their capabilities, he would appear to form a melancholy exception to this beneficial order of nature. Formed with feelings susceptible of the most exquisite enjoyment, yet doomed to a perpetual conflict of jarring emotions and heart-rending cares,—endowed with faculties capable of comprehending the most sublime mysteries, yet grovelling in the dust and expending his powers on empty trifles,—glowing with hopes and desires which look beyond the bounds of time and grasp eternity, yet fixing his affections on this

Digitized by Google

little spot of earth, contented with pleasures which perish in the using; and, after dragging out a few miserable and inglorious years, sinking at last into the silent tomb and mingling with the clods of the valley, a wretched outcast of nature and a blot on the face of creation. Revelation alone explains the darkness of the mystery. Neither the attributes nor the works of God are then sufficient upon which to found our hopes of an immortal life; on the contrary, they rather lead us to the belief that there is no hereafter; inducing us to regard death as the most benevolent act of the Creator, as releasing us from scenes of so much misery and distress.

The fact that "there is no tribe so dark and barbarous as to be without some kind of worship and some belief in a future state," is still no proof of its existence. It is not improbable, certainly not impossible, that from the earliest age, even from the fall of man, a tradition of this kind should have been handed down through all people and through all nations. It is quite clear that in the curse pronounced against Adam, temporal death as well as spiritual or eternal death was threatened. That both Adam and Eve understood the nature of the curse and the remedy which it promised, is plain, for he named his wife, after it had been pronounced, Eve or Chavoh, "because she was the mother of all living;" that is, as commentators observe, of all who should live for ever, by means of "the seed of the woman;" and Eve, at the birth of Cain, says, "I have gotten

Digitized by Google

a man, the Lord;"* that is, the promised Lord, or seed, who was to "bruise the serpent's head." That Adam and Eve became penitent and were accepted we also know; and as there can be no repentance without hope of forgiveness, we would conclude that they were aware what means they should adopt to remove God's wrath. They could not expect it in this world, where they were condemned to hard and painful toil, and to a death, at the end of their being, accompanied by horror and distress. They trusted they would be rewarded for their penitence after this life, and they cheered their immediate descendants with the same hopes through their toils and their difficulties. We can conceive nothing more probable than that the same comfort should have been afforded by father to son from that day even to the present; and thus this, like many other traditions, which, were we so disposed, we might trace from a very early period, almost becomes a universal creed. The fact, as it fairly stands, is no proof of an immortality, and the above explanation is offered as a mere suggestion. The feeling may, however, be instinctive, and we are far from denying "that a benevolent being should have implanted this propensity without the

* In our authorized version, this passage is translated, "I have gotten a man *from* the Lord." That this is agreeable to the Hebrew idiom, is admitted by all commentators; but we are inclined to adopt the opinion of those who have rendered it as given above; that reading appearing the most natural interpretation of the original words, קניתי איש את יהוה.

Digitized by Google

intention of gratifying it." Still, however, proof is absent. Lord Brougham here refers to Note VIII. which describes the ancient doctrines of the immortality of the soul; to this, however, we shall not refer, as the explanation we have offered above of the possession of such a sentiment by savages, is equally applicable to heathen philosophers.

Lord Brougham concludes his "proof" by a reference to the analogies which nature presents; his Lordship says these are "feeble helps," and even of a dangerous kind—because they are drawn *from material objects*. They are so far feeble proofs, as they are no proofs: they cannot, therefore, be dangerous, even though "they all rest upon the properties and the fortunes of corporeal existences"—which, however, they do not. The resemblance, for example, between the alternation of the seasons and the progress and decay of human life, is too obvious to have escaped the observation of any reflecting mind. Spring is the infancy and youth of the year—summer its vigorous and sober manhood—autumn its mellow age, when its fruits are reaped and its labours are at a close. At last comes winter—cold, desolate, and stark—an affecting type of hoary age and of death: the leafy honours of the woods have fallen—the flowers and grass which adorned the fields have passed away—the music of the grove has ceased;—nature, clad in a winding-sheet of snow, seems to indicate that vegetation has run its course and is annihilated. But, at the voice of spring, nature revives;—the sun, which,

Digitized by Google

skirting the verge of the sky had become feeble and cheerless, resumes its genial influences, and takes a wider circuit in the heavens;—young spring walks forth again in beauty—gentle zephyrs fan her bosom—flowers spring beneath her feet—and, wherever she smiles, the woods and lawns burst into life, and the voice of joy resounds. This is all emblematic of the destiny of man, as he undergoes the various vicissitudes of growth, maturity, decay, and death;—till, hearing the creative voice of a new spring, he bursts his bonds and lives again. But analogies of this kind are not so striking as that of those insects which, after being apparently dead and entombed, rise again, as it were, from the grave, and, waving their painted wings, flutter from flower to flower, and seem to live in a new world, amidst a paradise of sweets. But the sober and undeniable truth is, that the strongest of these analogies are nothing more than illustrations, and cannot be dignified by the name of solid arguments. They could not be so even if the analogy were complete; but it fails in its most important point. Go to the tomb of the caterpillar—it is empty. The same body which reposed in seeming death, has burst its shell, and has only assumed a new form. Go to the human tomb—the remains of what was once man are still there, mouldering into dust! But the reader will ask, Where, then, are the proofs of the immortality of the soul? *They are alone to be found in the pages of revelation*, before which all human reason must infallibly bow; and wo to

Digitized by Google

him who would substitute the one for the other. Such a mode of argument cannot for a moment be sustained; it leads at once to imposition and imposture, to blind obedience, superstition, and an abject deference to human authority. The dicta of Scripture are at once conclusive; or, as a writer has well observed, "the positive evidence of Scripture holds the same rank in theology as experimental evidence does in reference to any hypothesis in philosophy. As, in the latter case, there is no disputing in favour of a system against facts, phenomena, and experiments; so, in the former case, no reasoning can be valid in opposition to the positive evidence or express discernible authority." And, not only is it untheological, but unphysiological, being opposed to the opinion which we have already inculcated, that human reason is most fallible. In physics we may often infer with certainty the cause from the effect; but, in ethics and religion, where the morality of an act or the truth of an opinion is in debate, it is absurd to say that, because a fallible creature acts or thinks in this or that manner, he therefore ought to do so.

But in case our arguments should not satisfy the reader of the insufficiency of external nature, to prove more than the being of a God, and its utter incapability to meet or to overcome the problem of an eternity; let him consider the conclusions upon the subject drawn by a justly celebrated divine, and one of the living ornaments of the Protestant Church. "We hold," says Dr Chalmers in his ob-

Digitized by Google

servations on the defects and the uses of Natural Theology; "that the theology of nature sheds powerful light on the being of a God; and that, even from its unaided demonstrations, we can reach a considerable degree of probability, both for his moral and natural attributes. But when it undertakes the question between God and man, this is what it finds to be impracticable. It is here that the main helplessness of nature lies. It is baffled in all its attempts to decipher the state and the prospects of man, viewed in the relation of an offending subject to an offended sovereign. In a word, its chief obscurity, and which it is wholly unable to disperse, is that which rests on the hopes and the destiny of our species. There is in it enough of manifestation to awaken the fears of guilt, but not enough again to appease them. It emits, and audibly emits, a note of terror; but in vain do we listen for one authentic word of comfort from any of its oracles. It is able to see the danger, but not the deliverance. It can excite the forebodings of the human spirit, but cannot quell them—knowing just enough to stir the perplexity, but not enough to set the perplexity at rest. It can state the difficulty, but cannot unriddle the difficulty—having just as much knowledge as to enunciate the problem, but not so much as might lead to the solution of the problem. There must be a measure of light, we do allow; but, like the lurid gleam of a volcano, it is not a light which guides, but which bewilders and terrifies. It prompts the question, but cannot

Digitized by Google

frame or furnish the reply. Natural theology may see as much as shall draw forth the anxious interrogation, 'What shall I do to be saved?' The answer to this comes from a higher theology."

So apposite to our purpose are the remarks of Dr Chalmers, which follow the last quoted paragraph, that we must conclude our argument with them. "These," says he, "are the grounds on which we would affirm the insufficiency of that academic theism, which is sometimes set forth in such an aspect of completeness and certainty, as might seem to leave a revelation or a gospel wholly uncalled for. Many there are who would gloss over the difficulties of the question; and who, in the midst of all that undoubted outrage which has been inflicted by sinful creatures on the truth, and the holiness, and the justice of God, would, by merging all the attributes of the Divinity into a placid and undistinguishing tenderness, still keep their resolute hold of heaven, as at least the splendid imagination by which to irradiate the destinies of our species. It is thus that an airy unsupported romance has been held forth as the vehicle, on which to embark all the hopes and the hazards of eternity. We would not disguise the meagreness of such a system. We would not deliver the lessons of natural theology, without telling at the same time its limits. We abjure the cruelty of that sentimentalism, which, to hush the alarms of guilty men, would rob the Deity of his perfections, and stamp a degrading mockery upon his law. When expounding the arguments

Digitized by Google

of natural theology, along with the doctrines which it dimly shadows forth, we must speak of the difficulties which itself suggests, but which it cannot dispose of; we must make mention of the obscurities into which it runs, but which it cannot dissipate—of its unresolved doubts—of the mysteries through which it vainly tries to grope its uncertain way—of its weary and fruitless efforts—of its unutterable longings. And should, on the one hand, the speculations of human ingenuity, and, on the other, the certainties of a well accredited revelation, come forth to illuminate this scene of darkness—we must not so idolize the light or the sufficiency of nature as to turn from the firmament's meridian blaze, that we might witness and admire the tiny lustre of a glow-worm."

We have in the foregoing pages endeavoured to shew that neither the phenomena of mind, nor the attributes, nor the works of God, are sufficient to prove the immateriality of the mind; and still less the immortality of the soul. Either for the materiality or the immateriality of mind, there is no Scripture authority; and as for supposing that a belief in its immateriality is necessary to salvation, there seems not the slightest ground for doing so; with this view it is altogether unimportant to the conclusion whether we believe that the whole animal kingdom is actuated in its operations by a spiritual principle which perishes with the body in all but man, or that material organs are alone concerned in the production of the mental phenomena. Bu

Digitized by Google

with regard to the immortality of the soul the case is very different. True, external nature affords no proof for it; but then the Christian founds his faith upon Revelation, which distinctly tells him, that the soul is immortal; and explains the darkness of the mystery with which he is surrounded. It declares that the present world is not the ultimate destiny of man—that he is here in a state of preparation for immortality, and that, if he is not wanting to himself, he will rise more vigorous and lovely from his fall, assuming a new character, and taking a higher station in the state of existence; it exhibits the Almighty to us in the character of a father chastising his undutiful children for their profit, bringing good out of apparent evil, employing sin and death as the handmaids of holiness and immortality, making pain, disappointment, and grief, the harbingers of eternal joy, and converting the curse which blighted the earth into a blessing.

In comparing the phenomena of Mind as it appears in man and in other animals, we cannot but be struck that the former is alone able to rise to the contemplation of the great First Cause, and alone possesses faculties to conceive a future state of existence; and we cannot avoid feeling that it is our exclusive privilege, endowed as we are by the free gift of our Creator with an imperishable soul, to look forward through the vistas of time to the enjoyment of that life and immortality brought to light through the Gospel.

Digitized by Google

CHAPTER X.

OPINIONS OF METAPHYSICIANS AS TO THE NATURE OF THOUGHT.

We have above insisted on the necessity, on the one hand, of a certain susceptibility, and, on the other, of the stimulus of sensation, to the manifestation of thought; but this necessity was not always admitted. Before the time of Aristotle, thought was commonly spoken of as a distinct attribute of one particular part of the body, as life was of the body in general, and presumed to be from the first inherent in this part, and quite independent of any impression from without; while after his time it came to be more generally believed that thought is merely a modification of these foreign impressions, and that distinct from those it is nothing. Each opinion has in modern times also had its advocates, who imagine that in their tenets they are directly opposed to each other, as both are to the supporters of the doctrine above adopted: we shall perhaps find nevertheless, that, however they may differ in words, they agree in fact, not only with each other, but with those also who support the view of the subject which we are desirous of inculcating.

Digitized by Google

According to Plato, then, the commonly reputed father of the "Innate Idea" School, there are in the mind, from the beginning, certain immaterial beings, abstract forms and essences, eternal designs and models, types, architypes, and prototypes, of which material beings are only, as it were, the copies, and by which the mind ascertains the nature of these beings, and not by the properties of the beings themselves, which have in them nothing fixed or permanent. These immaterial beings may, in his opinion, remain latent till called forth by the perception of something material; but, when so called forth, it is only in the manner of a reminiscence, the senses being useful merely as joggers of the memory, and not as sources of original information. The same opinion is embraced by Descartes, with this modification, that he regards the immaterial beings, &c. of Plato, not as distinct beings, but as a part of the mind itself, and he was the first to apply to them the term *ideas*. According to Malebranche, however, nobody can doubt that ideas are really distinct beings, since they have, he says, real properties; and, with respect to their being innate in the mind, he observes, "it is absolutely necessary that God had from the first, before material beings existed, ideas of all which he was about to create, otherwise he could not have created them, and it is equally certain that God is intimately connected with the soul of man. Now, as by means of the soul we can see God, who represents all created things, it follows that the soul has

Digitized by Google

innate ideas of every thing which is in existence." Similar notions are promulgated, with certain modifications, by Bossuet, Fenelon, Leibnitz, and others. It was the last-mentioned philosopher who added to the celebrated axiom of Aristotle, of which we are presently to speak, Nihil est in intellectu quod non fuit prius in sensu, the words nisi ipse intellectus; which intellectus he believes to comprise some fundamental ideas, not all at once to be developed, but only as occasion draws them forth. From the vagaries of these, and other similar authors, Idealism, in all its purity, took its rise. With them the senses are of little use: they perceive material beings, not such as they are in virtue, as well of their own nature, as of the mind which takes cognizance of them, but such as they are in virtue of the innate notions of them in the mind alone; and many of them have accordingly considered every thing in the material world as a mere illusion, like the day-dream of a maniac, and have doubted of every thing—even of their own existence.

A diametrically opposite doctrine to this originated, as we have just observed, with Aristotle, and has been supported in modern times principally by Bacon, Locke, Condillac, and Buffon. With these philosophers, it is a fundamental principle that the mind is at birth a perfect carte-blanche, and that it acquires all its ideas and principles by experience alone, the senses being the only inlets to every species of knowledge. Hence arose the axiom just alluded to—Nihil *est in intellectu* quod non fuit prius

Digitized by Google

in sensu; and from their having thus, as it were, identified intellect and sensation, it became incumbent on them to prove that man, as he surpasses all other animals in the former, in the same degree excels them likewise in the latter. But the only sense in which man is decidedly superior to all brutes, is that of touch; and, as the chief organ of this sense is the hand, it became established among them, that all animals were intelligent in proportion to the perfection of this organ; the hawk and parrot, for example, among birds, and among quadrupeds, those furnished with clavicles, owing their superiority in this respect to the circumstance of their using their hands as organs of prehension, and that man owed all his perfection to the exquisite structure of his hand;—nay, Helvetius has even gone so far as to say, that, had a horse possessed the hand of a man, he would have been equally intelligent! In this way the mutual agency of the percipient being and of the impression to be perceived, has been neglected by both Idealists and Realists; and if the former made too little of the senses, regarding them as nothing, or worse than nothing, since they frequently only deceived us, the latter, in an equal degree, made too little of the mind, which they looked upon as a kind of soft wax or clay, capable of receiving impressions conveyed to it by the senses, but incapable of adding any thing to them in the way of either embellishment or deterioration.

But to descend a little to particulars. With re-

Digitized by Google

spect to the abstract forms and essences of material beings, supposed by Plato and Descartes to be inherent in the mind, either as distinct immaterial beings, or as integrant parts of the said mind, it is sufficient to say that the supposition is entirely gratuitous and unnecessary, and, what is worse, entirely unintelligible. It was well remarked by Diogenes, in conversation with the former on the subject, that, although he perceived the table and the goblet which were before them, he had no abstract notions of table-ity and goblet-ity,—he saw and understood the things themselves, but he had no conception of their types, architypes, and prototypes. The alleged proof, adduced by Malebranche, that ideas are not only innate, but substantial—namely, their possessing distinct properties—is quite inadmissible. Ideas have no properties,—they are nothing but a mode of existence of the thinking organ, acted upon by its proper stimulus; and are no more entitled to be considered substantial, than combustion or motion, which are, in like manner, modes of existence of the thing burning and the thing moving. The testimony also brought forward by the same author, of the innateness of these substantial ideas, founded on the intercourse of our souls with God—whose mind necessarily from the first embraced every thing—is that of a theologian, not of a physiologist; and presumes upon the notion, which we have already endeavoured to shew is false, that the mind and the soul are identical. It might likewise be further objected to this al-

Digitized by Google

leged evidence in favour of the innateness of our ideas, that our notions are as often false as true, unjust as just, which they could not have been, had they come to us directly through the medium which has been supposed; and this objection is particularly applicable to the ultra-Malebranchism of Fenelon, who represents our innate ideas as not only derived immediately from God, but identical with God,—"elles sont," he says, "Dieu même!" But it is in vain to follow the vague flights of divines on any subject of physiology: suffice it to say, that the illusory world of the idealist has no existence, and can have no existence, in nature. No function—and thought is a function—can exist without two conditions, a susceptibility of being acted on, and a power acting: the idealist makes but one,—not either of them individually, but both of them, as it were, united into one, or rather a new entity standing in the place of both, but not identical with either. It is quite true that we can have no ideas of external objects, considered *per se*, and that we cannot know any thing of them otherwise than as they affect our minds,—and therefore our notions of them must be derived, as well from the quality of our minds, as from the nature of the objects in question. The properties of colour, for example, of hardness, and so forth, have as close a reference to the thing perceiving, as to the thing perceived, what is one colour, or one degree of consistence, to one animal, being not necessarily of the same to others; and there is no such thing as colour, no

Digitized by Google

such thing as hardness at all, but where there is a being conscious of these properties. But it is not true that this being has, or can have, any idea of colour or hardness, independently of such bodies as are calculated to excite it, nor, consequently, that the senses are otherwise than essential to our having any ideas at all. The wildest maniac derived all his ideas originally from his senses,—his hallucinations arise from perturbed combinations of them. But the senses are not, nevertheless—as supposed by the Peripatetic School—all-in-all sufficient, the mind being a yielding mass, capable of receiving impressions from the senses, but not of contributing any thing to them. If this were the case, whence all the differences in the disposition, attainments, and character of different individuals under precisely similar circumstances? It is well remarked by Dr Barclay, that we may as well say that arts and manufactures are derived from the doors and windows of the work-shops by which the raw materials enter, as that thought is derived from the senses alone. There must be something within to act on these raw materials, and to construct out of them new fabrics, which are consequently the result of the combined operation of the thing acting and the thing acted on. Two conditions, we have repeatedly said, are essential to every function; and the Peripatetics, like the Academics, make but one,—a different one, indeed, but still only one. Our idea of colour or of hardness, results, not from the object alone, any more than from the mind

Digitized by Google

alone, but from the mutual agency of both; and any change in the constitution of either, effects a corresponding change in the idea in question.

So far, then, as words go, both the Idealist and Realist are equally mistaken; but it is amusing to observe that they are so in *words alone*, and that, in *fact*, they not only are both of them correct, but agree as well with each other, as with the advocates of the doctrines which we have above adopted. For what in reality are the abstract forms and essences of the former, and the carte blanche of the latter, but a susceptibility, resident from the beginning in the body, of being affected in a certain way; what is the information represented by the one school as merely revived, and by the other as originally communicated by the senses, but the stimulus to such an affection; and what, lastly, is an individual idea of either party but the result of the two mutually acting on each other? The chief difference is, that the Idealists have exaggerated the influence of the Percipient, the Realists, that of the thing perceived. Thus, among the former, Descartes distinctly defines an innate idea to be a *Faculty* of engendering ideas—not an idea, in the common and correct acceptation of the word; and Fenelon speaks of it as "*une regle* par laquelle on juge de toute"—not a judgment, but a capacity for judging. In like manner among the latter, Locke describes his carte blanche as a *Disposition*—a faculty to receive impressions, and distinctly states that it is from this capacity to receive these impressions,

Digitized by Google

as well as from the impressions themselves, that an idea arises. What is all this in the hands of either, but the view all along taken above? Both virtually admit the two conditions required, but each formally admits only one; both go hand in hand with Truth without perceiving her. But it is to Bonnet and Kant that we owe the fullest illustration of the real nature of thought. "Our brain," observes Bonnet, "is organized with direct reference to the wonderful operations of our mind; and the organs of our senses are, in like manner, adapted to the organization of our brain; but the latter are, in every thing, subservient to the former. And so it is with all the lower animals. The brain of man and the hand of man, the brain of the horse and the hoof of the horse, have a direct relation to each other; but the horse would be no more raised to the intellectual rank of a man by giving him a hand, than a man sunk to the condition of a horse by depriving him of it." The Philosophy of Kant is, in like manner, the mean of that of Plato and Aristotle, of Descartes and Locke; that is to say, he has the same general ideas as they had—for we have just endeavoured to prove that they do not essentially differ from each other—but without falling into their exaggerations on one side or the other. "The faculties of the mind," says he, "are a priori, but it is external occasions which determine their exercise: Thought is the form of being derived from both." It is true the continuance of thought, when every avenue of

Digitized by Google

sensation is apparently closed, is, at first view, certainly against this doctrine. But the avenues of sensation from the internal organs are never closed; and even though they were so, thought might continue for some time, without prejudice to the theory in question. Neither imitation nor sensation instantaneously ceases, on the abstraction of the powers by which they are severally excited, and the longer continuance of thought, once excited by the sensations, implies a difference in degree only—not in kind; nor can we with greater reason deny that thought was excited by sensations, because these are now quiescent, than that the motion of a tennis-ball was occasioned by the racket which struck it, because that racket is now at rest. In the most excursive reverie thought never wanders into a field which has not been, at one time or other, traversed by the senses; we may think of sirens, and mermaids, and golden mountains, which we have never seen, but we have seen the elements of them all, or we could never have fancied them.

A chapter devoted to the opinions of philosophers as to the nature of thought, would be incomplete without some notice of the modern doctrine of Phrenology. And such a notice becomes the more necessary, as that doctrine has this much in common with the view inculcated throughout this treatise, namely, that the manifestations of mind in the animal kingdom are proportioned to the development of its physical organ. The leading principle

Digitized by Google

of phrenology, then, is common to it and to the soundest modern physiology; namely, that the brain is the organ of the mind, or, more generally, that all the phenomena in the animal kingdom that can be termed mental, are manifested through the nervous centre. On this point there is no room for controversy, and those who have denied or disputed it, have only shewn how ill prepared they are with the information requisite for the proper investigation of the functions of the mind. The second great principle of phrenology, when expressed at least in the most general terms, is also an acknowledged truth of physiology, namely, that the nervous system, in the performance of its functions, does not act as one organ, but that separate parts of that system have separate endowments of action, or that it is an aggregate of organs, each possessed of a distinct function or functions. This, as we have seen above, is one of the most important discoveries in modern physiology; and it cannot be denied that the phrenological anatomists have contributed, in no ordinary degree, to the establishment and extension of it as a law pervading the operations of the nervous system. But it must be remarked that the part of this principle, which specifically applies to phrenology, is not included in, or deducible from, the physiological truth. Physiology has not yet pushed the division of the offices of the nervous organs into so many compartments as the wants of phrenology require. Physiology teaches, not with dogmatic confidence, but on rational grounds of belief, that the

Digitized by Google

anterior pillars of the cerebro-spinal axis are the sole originators of motion, and the nerves derived from them the only nerves by which the motive power is transmitted to distant organs,—that the posterior pillars of the same axis are the only seat of sensation, and the nerves arising from them, or perhaps ending in them, the only channels by which impressions made on remote parts affect sensation, —that the cerebellum is the organ of memory for the muscular sensations connected with the exercise of the voluntary motions of the body, and that the brain itself is the sole seat of intellect, volition, emotion, and passion. Physiology, then, does not here countenance phrenology further than by admitting the truth of subdivision of function with subdivision of parts; while phrenology carries the subdivision of function to an extreme degree with a corresponding assumption of the subdivision of the encephalon into as many distinct parts or organs. The difference in the modes of investigation pursued respectively in these two branches of knowledge, and the distinction in the evidence on which the conclusions in each rest, may be stated in a very few words. The conclusions of physiology are founded solely on the anatomical scrutiny of the nervous organs, and on the results of experiments made by cutting or removing certain parts in living animals; and no special function has been assigned to a part unless it possesses distinct boundaries discoverable by inspection, or rendered sensible by anatomical manipulation.

Digitized by Google

The phrenologist looks to evidence of a very opposite kind; he regards the surface of the brain in contact with the skull as developed in the ratio in which the aggregate of the organs conceived to make up the encephalon is developed, and determines the place of each organ, when, on examining the external surface of the head in the living body, he discovers, or thinks he discovers, an unusual extension of the skull peculiar to those individuals who are observed to excel their fellow-men in the exercise of some particular mental faculty. That the external surface of the skull very exactly corresponds with the surface of the encephalon, must be admitted by the candid anatomist; the figure of the skull is unquestionably determined by the development of the contained parts, nor can the slight deviations of the internal table from parallelism with the external, or the frontal sinus be any longer brought forward as objections of any considerable weight against the mode of investigation pursued by phrenologists. Neither can any logical objection be brought to bear against the plan on which the phrenologist proceeds in determining the seat of the organ. If every individual, who exhibits a peculiarity of mental operation, be without exception possessed of a peculiarity in the development of his skull, that is, if none but those who shew the mental peculiarity are distinguished by the physical development, the connexion between them as effect and cause is undeniable on any principle of sound reasoning. The only point

Digitized by Google

for inquiry here relates to the accuracy of the observation—of which we shall speak hereafter more conveniently when some other preliminary points have been adverted to.

Does physiology, then, afford any countenance to the supposition that the nervous organs correspond to such faculties as that which examines individual objects in detail, that which investigates forms, that which dwells upon colours, that which estimates size, that which calculates resistance, that which remembers localities, that which reckons numbers, that which determines to order, that which directs to the observation of events or actions, that which affords a nice perception of time, that which appreciates tune, that which gives a facility of acquiring language, that which compares the several conditions of objects, or that which impels to the penetration of causes: or again, to such as that which begets benevolence, or veneration, or firmness, or conscientiousness, or hope, or wonder, or ideality, or wit, or imitation, or self-esteem, or love of approbation, or cautiousness: or finally, to such as that which draws to amativeness, or the love of offspring, or creates concentrativeness, or produces friendship, or leads to brawling, or to murder, or to gluttony, or to the love of life, or to preserve secresy, or originates skill in mechanics? In answer to this question, it is in the first place to be remarked, that the convolutions of the brain which are in contact with the internal surface of the skull, attain their great-

Digitized by Google

est development in the higher animals, and that they are more particularly perfect in man. Yet in their very nature they seem to be but an appendage to the essential or central part of the organ, and are altogether deficient in some animals, as in birds, which possess many faculties, as the above list shews, in common with man himself. It must be conceded, however, to the phrenologist, that nothing in the range of physiological knowledge, proves that the supposed organs may not extend from the surface of the encephalon to the medulla oblongata, or at least to the upper extremity of the crura cerebri,—so as to constitute a series of medullary cones having their bases on the surface in correspondence with the portions of the skull mapped out as the seats of the faculties. On this supposition, the mass of each cone will be great in proportion to the prominence and extent of its base, as indicated by the portion of the skull declared to correspond to it. Physiology, then, at present, it must be confessed, leaves the whole of the cerebrum to the phrenologist for the construction of such conical organs, since it appropriates to that part of the encephalon no function but such as the faculties enumerated by him affords a substitute for,—or in the faculties above mentioned, intellect, volition, emotion, and passion, are sufficiently provided for. The case, however, is different as respects the cerebellum. The place which the phrenologist assigns to amativeness, evidently corresponds to the seat of that part of the encephalon,

Digitized by Google

while the physiologist has appropriated it to the memory of the muscular sensations by which voluntary motion is regulated, so that the phrenologist must come prepared to dispute with him the possession of this important point of attack. To enter upon the discussion of such details as this would lead to, forms no part of the plan of our present general outline of the subject.

To proceed, then, with the further consideration of the grounds of phrenology, we come next to inquire how far absolute volume can be regarded as determining activity of function. As respects different individuals of the human race, physiology does not afford the means of answering this question. That science has hitherto confined itself to comparing the development of the nervous system and state of the functions in one species of the animal kingdom, with its development and the state of its functions in other species higher or lower in the scale, so that it furnishes no criterion by which to judge of the relative states of development in different individuals of the same species, according to the degree in which the faculties belonging to that species are manifested. As the phrenologist then here far outruns the present conclusions of physiology, as to the exact connection of mere size of the organ with development of its function in animals of the same species, nothing is left in our choice but to try his postulates by general principles. His postulates on this head are chiefly two, namely, that the mere bulk of an

Digitized by Google

organ is not decisive of the activity of its function, without a comparison of the proportion which it bears to the other organs in the head of the same individual; and again, that besides bulk and proportion, something may be due to greater vital energy in the part. It was observed above, in speaking of the development of the nervous organs in man, as compared with their development in inferior animals, that the mere volume of the aggregate of several organs may be dependent on a variety of causes operating differently under slight differences of circumstances; but that proportionate volume of parts must be regarded as an unfailing evidence of their relative importance in the animal economy. As this was said in speaking of the comparison of parts in animals of different species, it is not altogether an admission of the first of the above postulates, yet it seems but fair to confess that the phrenologist is entitled to seek our assent on account of the strict analogy existing between the two cases. There appears, then, to be no reasonable ground for refusing to admit that the aggregate of certain organs may be smaller in one brain than in another, and yet that their functions may be more active, because their development bears a greater ratio to the entire mass, or, according to the phrenological estimate, to the entire surface of the skull. With respect to the second postulate above stated, it is not to be denied but that in different temperaments different degrees of vital activity belong to the living solids; nor can

Digitized by Google

the nervous substance be made an exception to this general rule, so that the second postulate may be also conceded to the phrenologists. But while it is conceded, it does not clearly appear that they can make any advantageous use of it in the explanation of mental phenomena, at least when the preceding postulate is before acknowledged. For the greater vital activity which difference of temperament bestows must be shared by the whole brain indiscriminately, so were this common influence withdrawn, the relative activity of all the organs would continue the same as before. The phrenologist, besides, calls on us to concede that the habitual exercise of a faculty increases its activity, and is even followed by an augmentation of the organ. Visible augmentation of the organ cannot be established satisfactorily; but physiology admits that organs so exercised in parents are prone to greater physical development in the offspring, or at least that such effects become manifest after two or three generations.

Our next attention is called to a very important principle which is assumed in phrenology—namely, that differences in individual character are essentially dependent on original differences of organic structure, while doubtless some small influence is conceded to the power of the circumstances under which each individual has lived before his faculties reach maturity. We have now to inquire, how far physiology bears out phrenology in this assumption. The opinion often inculcated by mere men

Digitized by Google

of letters, and sometimes by metaphysicians, that all men are born with equal faculties and susceptibilities, and that the differences actually observed among individuals are due to the differences in the circumstances to which each has been exposed, not only receives no countenance from physiology, but, on the sound principles of that science, must be condemned as altogether untenable. The brain is, in the strictest sense, the organ of the mind, and there is no reason to doubt, what the best authorities in physiology have commonly assumed, that every individual's present condition as to his sentient, intellectual, and moral nature, is what the actual condition of the nervous organ makes him. The evidence of this is, that it is the only supposition which agrees with the phenomena both of health and disease. Further, it is usually assumed, and on the justest grounds, that every mental operation must be attended with some physical change in the nervous organ; so that, while it is impossible to doubt but that the after development of the brain in the course of life is mainly determined by its actual condition at the time of birth, there is room for the supposition, that some considerable influence is exerted upon that development by the particular nature of the mental operations, to the reaction of which it has been subjected by the train of external circumstances distinguishing each individual's early years. Physiology does not at present enable us to estimate the exact extent to which this influence of the mental operations reacts

Digitized by Google

upon the development; but there is no ground for believing that the change upon the original susceptibilities is beyond a moderate alteration. Such an alteration must doubtless be attended with a change in the relative development of the nervous parts: yet even the most finished education appears to be incapable of making such a change on the internal parts as can become conspicuous externally. The children of peasants and labourers, though highly educated, and transferred from their earliest years to the society of the more intelligent orders, retain throughout life the form of head belonging to their original rank, while their offspring, in the course of two or three generations, seem to acquire gradually that form of head which belongs to those orders of society among whom the mental faculties are exercised to a greater degree. In as far, then, as the evidence of the change of form under the influence of external circumstances is an evidence of the alteration of susceptibility of mental operations, and it is sound physiological evidence, we must conclude that it is very gradual and within very narrow limits. The reader must see, I think, that a distinction is made in the above observations between the effect of education as storing the mind with knowledge, to use the popular language, and its effect as augmenting the original susceptibilities of the individual for mental operations. If the brain be, as strictly as we have represented it, the organ of mental function, it is impossible that its susceptibility of mental operations can be improved

Digitized by Google

by any cause without a change in its physical development; but there is no ground for believing that the mere acquisition of knowledge is necessarily attended with any such alteration of development.

It is often argued that no two individuals are exposed to exactly the same external circumstances, even though brought up together and treated as carefully as possible on the same plan; and therefore, that we are not at liberty to infer, that difference of circumstances may not have given rise to all the differences in mental and moral character that may be observed to distinguish them. The ready reply to this argument is, that there is no evidence of the mental phenomena produced by external causes reacting with such efficacy on the organ as to account for the differences actually observed. And if diversity of character, such as is often observed in two individuals brought up as much as possible alike, could be explained by such slight variations in the circumstances as can possibly arise in a case of this kind, how immense would be the effect, in producing diversity of character, of the remote extremes in the circumstances of education and training, such as many individuals to be met with in ordinary society have been subjected to? How many individuals do we see possessed of much the same moral and mental dispositions, though brought up under the most opposite discipline? The assumption, then, destroys itself, by proving too much.

It may seem at first sight that the view taken

Digitized by Google

above of the connexion between mental function and physical development is, in effect, an admission of the truth of phrenology. This, however, is far from being the case. It is, however, an admission towards the views of phrenology not made by many of its opponents; and yet we are mistaken if it be made in any spirit of partiality in favour of its doctrines, or in any other spirit than that of sound physiological truth. Throughout this treatise it has been inculcated that in the animal kingdom development of mental phenomena goes on progressively increasing with the expansion of the cerebral organs, and when we arrive at man, and come to compare the separate manifestations of the same phenomena in different individuals, analogy forces us to confess, in the absence of direct evidence, a persuasion amounting almost to a conviction, that the physical development of the brain must correspond in each individual with the activity of the mental phenomena. Phrenology can claim us as converts or disciples on no other ground than that many of its opponents deny what we admit, or rather what we inculcate. But what we here maintain is not phrenology, but physiology; it rests not on phrenological but on physiological observation. To this difference Hufeland referred when he said, "organology is unquestionably true, but organoscopy is doubtful."

Having pointed out, then, the very considerable extent to which physiology supports phrenology, it is time to direct the attention of our readers to the diffe-

Digitized by Google

rences which still exist between them. The grand point of opposition between them is that to which the quotation from Hufeland refers, namely, that physiology has hitherto acknowledged no method of subdividing the brain or the general seat of intellect, volition, emotion, and passion, into separate parts, or of attaching a special function to any particular portion of that organ. The division, then, of the encephalon into thirty-five organs,* corresponding to as many faculties or propensities, sentiments, knowing and reflective faculties, rests altogether on the evidence peculiar to phrenology, and derives no immediate countenance from physiology.

In remarking, then, on the degree of credit to be attached to the particular evidence on which phrenologists rest their doctrines, it will form no part of our purpose to seek out the more vulnerable points for attack, or, as has been too often practised by its opponents, to seize on such parts of the doctrine as may be made to appear in a ridiculous light to superficial reasoners. A fair and candid view of the subject is what we desire to present to our readers; a view at once guarded from the spirit of determined hostility, and from that of blind partizanship. No subject in the whole range of human knowledge more loudly calls for an impartial investigation; for if no branch of inquiry has been more misrepresented, ridiculed, and calumniated by enemies, few have suffered more injury from the weak homage and adulation of partizans. By crowds of the lat-

* See Combe's "System of Phrenology." Edin. 1836.

Digitized by Google

ter the science has been regarded as a sort of pleasant legerdemain, a kind of intellectual palmistry by which to practise on the credulity of their acquaintance, while the fictions or exaggerations, which they have employed to raise wonder, have been received by the literary expounders of the doctrine as facts, and gravely uttered to the world as proofs of the truth of the doctrine. Others have been permitted to bring forward, in recognised publications of the phrenological school, crude speculations and reasonings, in behalf of the doctrine, such as would hardly impose on an unbiassed school-boy. If the established schools of philosophy still refuse to recognise the claims of phrenology to the rank of a science, they have at least this excuse, that if its partizans are not the supporters of a pseudo-science, they are very certainly chargeable with much pseudo-reasoning. The abettors of phrenology have undertaken to convince the world of a most important fact; a fact of the highest interest to the happiness of mankind, namely, that the intellectual and moral disposition of every individual is discoverable by the inspection of his skull, and the world is entitled to expect that those who take on themselves the onus of proving a thing so new, and so full of momentous consequences, will set about the task with a gravity becoming the subject, and keep their sober reasonings apart from the idle frivolities of those who have no other object in view than to consume a leisure hour. Whoever has looked into the phrenological periodicals will be at

Digitized by Google

no loss to recognise the justice of this censure. As a specimen of the looseness of reasoning permitted in these acknowledged organs of the school, we will refer to a series of papers in the Phrenological Transactions, which are not the less mischievous in their effects, because they are written with greater ability than belongs to most of the productions to which the above censure applies. One phrenologist chooses characters from Shakspeare, distinguished by some prominent moral disposition. He frames a fictitious description of a cranial development corresponding to the character as depicted by the dramatist—this he delivers to another phrenologist, and calls on him to pronounce upon the dispositions of the person to whom this development belongs, as if it were drawn from the head of an acquaintance; the latter accordingly draws up a character which does bear a certain resemblance to that of Iago, or whoever else was chosen from among the dramatis personæ of Shakspeare. The first phrenologist holds up his hands in wonder—a second Daniel is come to judgment! This is an experimentum crucis in evidence of the truth of phrenology; and the public are straightway called in to witness the same irrefragable demonstration of the infallibility of the phrenological faith. The conclusion is worthy of a Professor of Palmistry. There is no need to turn to the idola of Bacon, or yet to the "*Barbara celarent*," to detect the fallacy here; it stares us in the face. Where did the first phre-

Digitized by Google

[illegible] development of [illegible] in the catalogue [illegible] the second phrenologist [illegible]—where but [illegible] In this catalogue the facul- [illegible] to the organs. The [illegible] of the catalogue. [illegible] organs, and [illegible]—he, wonder- [illegible] off from the ca- [illegible]—and this feat [illegible] the correct- [illegible]

[illegible], we have now [illegible] the inductive evidence in favour of phrenology, as laid down by its more authoritative supporters. It was before noticed that the first discovery of the organs and faculties, and the alleged cumulative evidence in support of the discovery, are drawn from the observation of an unusual extension of the dimensions of the skull, at some definite spot, in those individuals who are distinguished beyond their fellow- [illegible] some particular mental operation. [illegible] to this, that some assistance [illegible] nation of the places of [illegible] after confirmation [illegible] from the suppo[illegible] between [illegible] those [illegible]

Digitized by Google

seats of such faculties or powers as they possess in common with men.

In reading the history of the first discovery of the organs and faculties by Gall, a sober mind cannot help being forcibly struck with the impression, that here is a man of playful fancy indulging his peculiar bent in the physiognomy of the head on grounds a little more solid, indeed, than those on which men are accustomed to build castles, towers, and cities out of the clouds, or to see familiar scenes in a cheerful fire; but still that it is fancy with something more of a method in it.

Whatever may finally turn out to be the opinion of philosophers on this point, it is not to be lost sight of at present, either by phrenologists themselves, if they wish to take the most effectual steps for the propagation of their tenets, or by their opponents, if they are desirous of applying judiciously to the same the tests of philosophic truth, that systems of opinions, as extensive as phrenology embraces, have been framed, bel... and propagated with as much zeal and suc... ...gh in the end
been disco... ...e original evi-
furnishe... the confirma-
arts, ...ertions of hun-
...s of ... ...ther foundation
...n ... ...on a small sprink-
... system is not to
...he facts of the case
...nce; still less is the
...when he crowds his

nologist find the materials for the development of Iago's skull? Nowhere surely but in the catalogue of the organs? Where did the second phrenologist find the materials for Iago's character—where but in the same catalogue? In this catalogue the faculties are set down opposite to the organs. The thing to be proved is the accuracy of the catalogue. The first phrenologist picks out a few organs, and hands the list of them to the second—he, wonderful man that he is, is able to read off from the catalogue the corresponding faculties—and this feat is gravely put forward as establishing the correctness of the catalogue.

To pass from such shallow sophistry, we have now to consider what weight is due to the inductive evidence in favour of phrenology, as laid down by its more authoritative supporters. It was before noticed that the first discovery of the organs and faculties, and the alleged cumulative evidence in support of the discovery, are drawn from the observation of an unusual extension of the dimensions of the skull, at some definite spot, in those individuals who are distinguished beyond their fellow-men for some particular mental operation. We may add to this, that some assistance in the original determination of the places of the organs, as well as in the after confirmation of the decision, has been drawn from the supposed correspondence in development between the skulls of certain inferior animals, and those parts of the human skull, alleged to be the

Digitized by Google

seats of such faculties or powers as they possess in common with men.

In reading the history of the first discovery of the organs and faculties by Gall, a sober mind cannot help being forcibly struck with the impression, that here is a man of playful fancy indulging his peculiar bent in the physiognomy of the head on grounds a little more solid, indeed, than those on which men are accustomed to build castles, towers, and cities out of the clouds, or to see familiar scenes in a cheerful fire; but still that it is fancy with something more of a method in it.

Whatever may finally turn out to be the opinion of philosophers on this point, it is not to be lost sight of at present, either by phrenologists themselves, if they wish to take the most effectual steps for the propagation of their tenets, or by their opponents, if they are desirous of applying judiciously to the same the tests of philosophic truth, that systems of opinions, as extensive as phrenology embraces, have been framed, believed, and propagated with as much zeal and success; though in the end it has been discovered that neither the original evidence furnished by the inventor, nor the confirmatory parts, added by the devoted exertions of hundreds of disciples, have had any other foundation than the vivid workings of fancy on a small sprinkling of facts. The inventor of a system is not to be trusted in the exposition of the facts of the case without the most rigid surveillance; still less is the ardent partizan to be relied on, when he crowds his

Digitized by Google

pages with confirmatory evidence. If you refuse both, it may be asked, who then are we to believe? That question implies that it is necessary that we should decide, on the instant, whether phrenology be true or unfounded. There is no such necessity in the world of science; a patience of ignorance being one of the chief elements of the philosophic character; a determination to abide unweariedly that fulness of time, when truth shall unfold itself. Now, there cannot be conceived a subject in which such patience is more requisite than phrenology. A thousand probable sources of error beset it on every side. It professes to solve a mystery, and offers at once abundant food to our cause-seeking propensity,—two properties which the history of mankind teaches us to have belonged pre-eminently to almost all the false views which have made the most rapid progress, and obtained the greatest currency among men. It is a subject of vast extent, too great to be investigated within any moderate limits of time, including, as it does, all that relates to the sentient, the intellectual, and the moral nature of man, or the entire sciences of metaphysics and morals. Nor does it limit itself, like these sciences, to the mere indication of the general laws under which intellectual and moral phenomena take place in the minds of all; but professes to explain the origin of individual differences of character, both intellectual and moral; or instead of being studied, like metaphysics, by reflection on the subjects of our own consciousness, it sends us abroad into the world to

Digitized by Google

scrutinize the dispositions of the individuals to be met with in society; to dive into their secret thoughts; to grope out the most concealed parts of their characters, and then to compare what we have learned on these points with the contour and configuration of their skulls. If it be easy to measure the dimensions of the skull, is there no difficulty, no chance of error in estimating men's dispositions and characters? Or is it not true that there is no case in which so many palpable errors are daily committed by men as in the estimate of the character of their associates and contemporaries? But if it be difficult to estimate exactly the characters even of those with whom we live in frequent intercourse; is it found more easy for a man to take an unbiassed account of his own character? Or is it not acknowledged on every hand that there is nothing of which men are so grossly ignorant as of the knowledge of self; and yet a great part of the evidence in favour of phrenology, in those cases where the tests are most accurately applied, depends upon the report given by the individual, whose head is subjected to examination, as to his own powers, dispositions, and sentiments. No one who reflects upon the difficulty will seriously say that a man is a competent witness of the degree in which he possesses those faculties, or that his report can have that justness and exactitude which are required in serious inquiries to shew, as an evidence of the truth of phrenology, their correspondence with the development of his head.

Digitized by Google

When, then, we consider the numerous sources of error which cannot but arise from those several causes, we shall be inclined to pause before giving our implicit assent to phrenology, or admitting that its conclusions are the result of a rigid induction from observed facts. These difficulties are inherent in the very nature of the subject, and altogether inseparable from the prosecution of it, so that nothing but length of time can be expected to overcome them.

But besides those sources of error, which spring from the very nature of the inquiries in which phrenology embarks, there are others which flow at present from the novelty of the subject, the hostility which it has provoked, and the spirit of partizanship which has been, in consequence, engendered in its behalf. No system of philosophic opinions was ever matured into truth under such a warfare of attack and defence as phrenology has been hitherto exposed to. The spirit of truth flies from violence, and is in vain courted to return till the acrimony of abuse and mutual recrimination is laid aside, and the contending parties are content to exchange their tone of defiance for the calm and sober intercourse of philosophic disputation. The debate between the phrenologists and anti-phrenologists has hitherto borne more the aspect of a political contest than that of a rational inquiry into scientific truth. It almost reminds us of the disputes between the Universalists and Realists, when kings and armies were ranged on opposite sides of the question, and the

Digitized by Google

penalty of death was sometimes the lot of the vanquished. We have not, indeed, seen bloodshed or the actual warfare of brute force employed in this contest; but the means employed on either side have been hardly better fitted to further the cause of truth, than the event of a battle-field. Indiscriminate assemblages of people, and the rhetorical and exaggerated statements which must be addressed to them, or into which they will convert whatever is addressed to them, are much more available for gaining a political object by agitation, than for settling the truth of numerous intricate questions depending for their solution on a nice observation of facts. When we consider the violence with which phrenology was assailed on its first appearance, we cannot, perhaps, justly blame its supporters for forming themselves, for mutual support, into associations and societies, and encouraging the public to join them; yet it surely will not be denied that such societies, however well adapted to serve the spirit of propagandism, must prove fertile nurseries of error in all that concerns the investigation of moral and metaphysical truth. The exaggeration or the suppression of facts and errors of inference to which the human mind, without any imputation on its veracity, becomes so prone under the influence of preconceived opinion, run small risk of being detected and exposed in an assembly composed of men sworn to one faith, combined together for the express purpose of spreading and defending that faith, and taught to regard, not the discovery of

Digitized by Google

truth, but a triumph over their opponents as the great object of their exertions. In such an assembly, to doubt or to hesitate with respect to any one article of that faith which the great apostles of the doctrine inculcate, must be looked upon as a species of infidelity to be shunned as a crime. We have no hesitation, then, in setting down phrenological societies among the causes detrimental to the progress of phrenology, if it be in reality a well founded doctrine.

We are compelled, then, to distrust the conclusions of phrenology, not because there is any thing in the principles on which it is founded at variance with the soundest physiology, or because the mode of investigation, practised by its supporters, is incapable of verification, but because, while the facts on which it is alleged to rest are of a deceptive nature, and of very difficult determination without the nicest possible observation; the subject up to the present time has been prosecuted under circumstances extremely unfavourable to the establishment of any description of philosophic truth.

The questions connected with the function of the brain bearing on this subject, which time alone can decide, and it may be that but a few years will be required for the purpose, may be stated within a narrow compass. Physiology is most probably already on the point of determining whether one of the leading principles of phrenology be well or ill founded, that is, whether the brain, which it acknowledges to be the general seat of intellect, volition,

Digitized by Google

desire, emotion, passion, act as one organ in these several states, or be composed of a plurality of parts, each endowed with a distinct mode of mental action, such as shall exhaust these its more general attributes. If we obtain this information from Physiology, its effect may either be the confirmation of the present system as founded by Gall in all its essential parts, or, what is by no means unlikely, it may shew a necessity for an entire remodelling of that system.

While, however, physiology may possess the means of determining this great principle on grounds peculiarly its own, it is by no means proper that the cultivators of that science should refuse to investigate the same point by the kind of evidence which phrenology employs. Men trained in the severe pursuits of physiology are more competent to the task of nice observation of this kind than most of those who have hitherto engaged in it; and if they begin their observations with a total distrust of all that has hitherto been done, admitting nothing but upon repeated evidence, and guarding carefully against the besetting sin of over-haste to rear a system, while they keep themselves free from the trammels of partizanship and the obligation of allegiance to associations, and bring the fruit of their labours before the established scientific bodies, composed of men free to detect every unguarded assumption, we shall not long remain in doubt whether phrenology is to triumph or to be sent to repose with the

Digitized by Google

countless hypotheses which have, for a short season, amused or perplexed the minds of men.

One important description of evidence for the confirmation or refutation of the doctrines of phrenology of which its supporters profess to avail themselves, but of which they have hitherto made very little use is, in particular, open to physiologists, namely, the comparison of the cranial development of the inferior animals with the state of their faculties. The use phrenologists have hitherto made of this kind of observation serves rather to make us distrust their conclusions than to confess the accuracy of them. There is nothing to be found in their writings like a connected series of observations bearing upon the subject; it would seem, indeed, as if they never resorted to the lower tribes of animals, but to bring some isolated case to back a weak point in their system. Vimont, it is true, has published a book on Human and Comparative Phrenology, but the importance of his observations is by no means commensurate with the size and expense of his work.

These remarks on the doctrines of phrenology we must now bring to a close, as they have been extended to as great a length as their incidental connexion with the subject of this treatise can claim. Nor, indeed, had our space permitted, would it have been of much utility to extend our attention to any detailed examination of the particular evidence on which the establishment of each organ and corresponding faculty is believed to rest.

Digitized by Google

It is impossible to disprove alleged facts, however little foundation they may actually possess. We can but examine the testimony in their favour, and pronounce on general grounds, as has been already done in regard to the whole system collectively, how far it seems entitled to credit.

Whatever is to be the fate of phrenology, we cannot but anticipate that a new period in its history is about to open; that is, that it will in future be treated as a rational hypothesis, the grounds of which deserve to be examined with a calm and deliberate attention. Without such a calm and deliberate attention, the difficulties which we have shewn to beset the subject so thickly from its own inherent nature, whether we look to the chance of establishing it as a system of truth, or of refuting it as a delusion, cannot possibly be overcome. But many reasons concur to lead us to the belief, that the tests of truth and of error will be applied to this system, before much time elapses, with far greater efficiency than in the past period of its existence. The extraneous sources of error and difficulty must fast disappear. It has gone through the fierce ordeal of animosity to which a new doctrine, interfering largely with established opinions, is always subjected; but this animosity cannot last for ever,—it is already on the decline, and must soon give way, on the part of the world of science, to a desire to investigate dispassionately an hypothesis which offers so large a field of interesting inquiry.

Digitized by Google

CHAPTER XI.

OF REASON IN ANIMALS.

Now, as it is to sensation, distinct from thought, that we have ascribed all the motions of organized beings, properly called instinctive, so it is to the head of thought—the last and noblest function of such beings—that we must refer all those distinguished by the name of rational.

Of such motions as these, in plants, we have no unequivocal indications; and it seems probable that the highest source of motion in them is instinct, the highest function sensation.

And, that the same is the case also with quite the lowest tribes of animals, can hardly be doubted. The corallines betray no evidences whatever of any function approaching to thought, and its exercise is very questionable in most other zoophytes. But in insects in general, motions excited by this function are sufficiently obvious, and in some of them exceedingly striking. Thus, though it is from instinct probably that the ant hoards up grain, is it not from reason that she bites off the germinating part of it, if it have ever sprouted on her hands?

Digitized by Google

and, though it is probably from instinct that the spider constructs her web, is it not from reason that she refrains from seizing a fly upon it, if she observe at the same time an enemy to be dreaded. The story also related by Darwin, and so frequently repeated since, seems to us quite conclusive in favour of the reason of some insects. A wasp had caught a fly, almost as big as herself, with which she attempted in vain to rise in the air. Concluding that the weight of her prey was the impediment, she alighted, and sawed off the head and tail, before she again took to flight. The weight was now no obstacle to her progress, but she had not calculated upon the wind catching the wings of her victim, and thus retarding her; which, however, she no sooner observed to be the case, than she again alighted, and, having deliberately removed first one wing and then the other, carried it off triumphantly to her nest!

Many facts analogous to these are on record. M. Cossigny saw, in the Isle of France, a sphege attempt to drag a dead cockroach into its hole, which was too big to enter it. After several ineffectual attempts, the animal reduced the size of its prey by biting off its elytra and legs, and then easily effected his purpose.—(*Reaum.* vi. 283). That insects gain knowledge from *experience*, is proved by Huber (*Linnean Transactions*, vol. vi.), who states, that he has seen large humble bees when unable, from the size of their head and thorax, to reach the bottom of the long tubes of the flowers of beans, go

Digitized by Google

directly to the calyx, pierce it as well as the tube with the exterior horny parts of their proboscis, and then insert their proboscis itself into the orifice and abstract the honey. Kirby and Spence noticed holes at the base of the long nectaries of *Aquilegia vulgaris*, and attributed them to the same agency; and, to use their words, "from these statements it seems evident, that the larger bees did not pierce the bottoms of the flowers until they had ascertained by trial that they could not reach the nectar from the top; but that, having once ascertained by experience that the flowers of beans are too strait to admit them, they then, without further attempts in the ordinary way, pierced the bottoms of all the flowers which they wished to rifle of their contents." —(*Entomology*, ii. 522). Petit-Thouars observed the same fact with regard to other flowers.—(*Nouveau Bulletin des Sciences*, i. 45).

That insects communicate and receive information, is fully proved by every historian of the ant and the hive-bee. Kalm relates (*Travels in North America*, i. 239), that the celebrated Dr Franklin told him that, having placed a pot containing treacle in a closet infested with ants, these insects found their way into it, and were feasting very heartily when he discovered them. He then shook them out and suspended the pot by a string from the ceiling. By chance one ant remained, which, after eating its fill, with some difficulty found its way up the string, and thence, reaching the ceiling, escaped by the wall to its nest. In

Digitized by Google

less than half an hour a great company of ants sallied out of their hole, climbed the ceiling, crept along the string into the pot, and began to eat again. This they continued until the treacle was all consumed, one swarm running up the string while another passed down. That one ant must have communicated the situation of the pot to its comrades, and guided them to it by the only road by which it was accessible.

But it is principally in the several tribes of vertebrate animals, that we observe all the same intellectual faculties—differing only in degree—and all the same propensities, which display themselves in man. They learn by experience to procure the aliment destined for their nourishment, to put in practice the means proper for their own preservation and that of their young, to combine together, not only habitually, but in cases of sudden emergency, and to regulate their conduct in general according to circumstances, and they may be artificially instructed in some things almost as readily as a child. Thus, although in their selection, each of its own peculiar kind of food, they are guided probably by instinct alone, it is not unfrequently reason which directs them how to procure it. A crow, for example, has been observed after having caught a shell-fish, the covering of which she could not break, to rise with it into the air, and, dropping it from on high upon a stone, to make an easy prey afterwards upon the meat which it contained; and we all know the story of the poet Æschylus, whose

Digitized by Google

death is said to have been occasioned by an eagle having in this manner dropped a tortoise on his bald head, which she had mistaken for a rock. Dr Fleming bears witness to this fact in the history of birds, with some important additions. "Thus, for example," he says, "we have seen the hooded-crow in Zetland, when feeding on the testaceous mollusca, able to break some of the tenderest kinds by means of its bill aided in some cases by beating them against a stone; but as some of the larger shells, such as the buckie and the whelk, cannot be broken by such means, it employs another method, by which, in consequence of applying foreign power, it accomplishes its object. Seizing the shell with its claws it mounts up into the air, and then loosing its hold, causes the shell to fall among stones (in preference to the sand or the soil on the ground) that it may be broken and give easier access to the contained animals. Should the first attempt fail, a second or third is tried, with this difference, that the crow rises higher in the air in order to increase the power of the fall, and more effectually remove the barrier to the contained morsel. On such occasions we have seen a stronger bird remain an apparently inattentive spectator of the process of breaking the shell, but coming to the spot with astonishing keenness when the efforts of its neighbour had been successful, in order to share in the spoil. (*Philosophy of Zoology*, i. 231.)

The common throstle (*Turdus musicus*) adopts the same method to break the shells of *Turbo lit-*

Digitized by Google

toreus and *Trochus conuloides.* These birds are well known to feed on snails, fracturing their brittle shells by taking them in their beaks and knocking them against a stone. Periwinkles, however, require considerable force to break their shells, and the bird effects its purpose by letting them fall from some height on the hard stones. This is only one remove—and it is a remove perhaps rather in favour of the birds—from the well known practice of the monkey, which, when its teeth are inadequate to crack a nut, uses a stone for the purpose. Although perhaps the following passage, which we translate from the French as quoted by Dugald Stewart from Bailly, the author of *L'Histoire de l'Astronomie*, gives it perhaps in favour of the monkey. "One of my friends, a man of intelligence and veracity, communicated to me two facts witnessed by himself. He had a very sagacious ape; he amused himself with giving the animal nuts, of which it was very fond, but as he threw them down at some distance, the ape, confined by his chain, could not reach them; after many efforts ineffectual to any purpose but that of whetting his invention, the ape seeing a servant pass with a napkin under his arm, snatched the napkin and made use of it to reach the nuts and bring them towards him. To break the nuts required a new exertion of ingenuity; this he accomplished by placing the nut on the ground and letting a stone or pebble fall from a height sufficient to break it. You remark that without the benefit of Galileo's knowledge of the laws of falling bodies, the ape had observed the

Digitized by Google

force which such bodies acquire in their descent. This plan, however, did not succeed on every occasion. One day it had rained, the ground was soft, the nut sunk into it so as to prevent the stone from taking effect. What contrivance does the ape fall on? He looked about for a tile, set the nut upon it, and letting the stone fall he broke it without any farther difficulty." (*Discours et Memoires par l'Auteur de l'Histoire de l'Astronomie,*" Paris 1796, tome ii. p. 126.)

Instinct, or the mere sensation of a want, could never have suggested devices like these, implying, as they do, at once *attention* to the effects of the concussion of a brittle and an unyielding substance, and the influence of height on gravitation in increasing this concussion; *memory* of such previous experience; *comparison* between substances of different degrees of consistence and between different heights; *judgment* in selecting a particular substance and height best adapted for the purpose; and REASON in concluding that what had happened before under certain conditions would happen again. Further, although all animals are by instinct prompted to self-preservation, it is often reason which suggests to them where danger is to be apprehended, and how it is to be avoided. Thus it is well known that a scarcely fledged bird allows itself without any apprehension to be approached by boys, of whom she is soon taught by experience to stand in deadly fear; and it has been frequently noticed, that all the brute inhabitants of a district, on its first discovery by man, are generally perfectly fear-

Digitized by Google

less of him, and only come gradually to regard him as an enemy. All the elements of thought are here likewise obviously put into requisition. And in avoiding apprehended dangers either to themselves or offspring, what intelligence is frequently displayed by the inferior animals! What teaches the pigeon to remain on her perch when an eagle is at hand, but a reasonable persuasion of security, founded on the observation that it is only or chiefly when on the wing that the members of her tribe are clutched by the noble bird; and what instructs the hare to squat on the approach of the greyhound, but a reasonable conviction, founded on experience, that her safety depends rather on concealment than on speed? Why does she also abstain in general from feeding near home, and, when the snow is on the ground, refrain from stirring out as long as possible, except from the apprehension that the devastation which she might produce in the former case, and her footsteps in the latter, would betray her hiding-place? An experienced deer, moreover, knows how to elude the hunter by innumerable feints; and the tricks of an old fox, both in attaining his prey and avoiding the snares set for him, are often so ingenious as to have rendered the term emblematical of a cunning fellow. Again, it is from instinct that birds build their nests, but it is from reason that they make them inaccessible if they have ever had their eggs stolen; and accordingly, certain tribes, which, under ordinary circumstances, construct their nests directly among the

Digitized by Google

branches of trees, in districts which are infested by monkeys, make them to hang from these branches in such a manner as to elude the grasp of the spoiler. The devices also frequently resorted to by the partridge and other birds, as well as those of cats and many other quadrupeds, to divert the attention of passengers from the situation of their nests and lairs, by enticing them to attempt their own capture, and other means, are known to every schoolboy, and speak volumes in favour of the presumption of their reasoning powers. But the occasional co-operation of the lower tribes of animals, implying, as it does, previous consultation with respect to the best means of attaining some particular object—to say nothing of their habitual combinations preparatory to migration and so forth, which are probably instinctive alone—is still more remarkable than any action prompted by their individual intelligence. The following is related by Father Bougeant:—" A sparrow finding a nest that a martin had just built standing very conveniently for him, possessed himself of it. The martin, seeing the usurper in her house, called for help to expel him;—a thousand martins came full speed and attacked the sparrow, but the latter, being covered on every side, and presenting only his large beak at the entrance of the nest, was invulnerable, and made the boldest of them who durst approach him repent of his temerity. After a quarter of an hour's combat, all the martins disappeared. The sparrow thought he had got the better; and the

Digitized by Google

spectators judged that the martins had abandoned their undertaking. Not in the least. Immediately they returned to the charge; and each having procured a little of that tempered earth with which they make their nest, they all at once fell upon the sparrow and inclosed him in the nest to perish there, though they could not drive him thence."

To these striking instances of the exercise of reason in the lower animals it might seem unnecessary to add any others; but as we are well aware that there is a strong repugnance on the part of many well informed and judicious people to receive evidence of such a power in other creatures than man; and as some of the instances before stated may be perhaps by some persons reduced to the rank of instincts, we propose to lay a few illustrative and well marked examples of reason in animals before our readers. We shall begin with mammals, and pass on to birds, fishes, and reptiles. And first, of the dog, which might afford to proud imperial man many lessons of conduct and morality which it were well for him if he would adopt; and the "brute," often less brutal than his savage master, has displayed actions which might make his tyrant lord almost ashamed of his humanity.*

* Our friend Dr Duncan of Ruthwell has recorded, in his interesting "Philosophy of the Seasons," a conversation to which, as a boy, he listened between the two poets Burns and Blacklock. The subject was the fidelity of the dog. Burns took up the question with all the ardour and kindly feeling with

Digitized by Google

These actions are not instinctive but rational. Witness the effects of his reasoning powers—his thinking faculties—in lessening the dangers of the winter storm, and mitigating the rigours of an ungenial climate. We allude to the dogs of St Bernard; their history is well known, and surely it is not instinct that sends them on their errands of humanity; it is not instinct that prompts them, when the sky is dark and clouded, and the winds howl, and the snow swirls through the freezing air, to leave their warm and cheering lair before the convent fire to seek the hapless passengers exposed to all the dangers of the mountain pass. It is not instinct that teaches them, when they find an unhappy wanderer sleeping beneath some thundering avalanche, a sleep which promises to wake him in

which the conversation of that extraordinary man was so remarkably embued. "Man," said he, "is the God of the dog. He knows no other; he can understand no other;—and see how he worships him! With what reverence he couches at his feet; with what love he fawns upon him; with what dependence he looks up to him; and with what cheerful alacrity he obeys him. His whole soul (*? mind*) is wrapped up in his God; all the powers and faculties of his nature are devoted to his service; and these powers and faculties are ennobled by the intercourse. Divines tell us that it ought just to be so with the Christian; but the dog puts the Christian to shame."—"The truth of these remarks," adds the Rev. Doctor, "which forcibly struck me at the time, have since been verified by experience; and often have events occurred which, while they reminded me that 'man is the God of the dog,' have forced from me the humiliating confession, that 'the dog puts the Christian to shame.'"

Digitized by Google

eternity, to set up a continued hoarse and solemn bark, and thus to bring the watchful monks to their assistance. We grant it is instinct which enables them to smell the perishing traveller ten and sometimes fifteen feet beneath the snow; but we hold it is reason that sends them on the search, and makes them give notice to their pious masters of the discovery they have made. It may be said they are trained to this; be it so: but an animal, be it man or brute, is rational in proportion as he is educatable. Captain Brown, in his anecdotes of dogs, has detailed many of the shepherd's collie, where wisdom little short of human has been displayed in the extrication of their masters from dangers to which the inhabitants of mountainous districts are peculiarly exposed. But we must refer our reader to that gentleman's very entertaining and instructive work.

There are few pictures more beautiful to the reflective mind than the care and intelligence with which the dog will lead his blind master. Faber, in his "*Exposition des Animaux de la Nouvelle Espagne*," as quoted by Virey, has described at great length the sagacity which the animal upon these occasions exhibits; and few who reside in the great cities of Europe can have failed to observe it. The dog leads the beggar from his home in the morning to the spot where he is to solicit charity, guiding him by the most direct route, and, with the greatest anxiety, avoiding obstacles, such as broken pavements and heaps of rubbish, over which he might stumble; in the evening, with the

Digitized by Google

same care, he is conducted to his home, where the faithful guide receives, as a recompense for his fidelity, a few morsels of bread, frequently unwillingly doled out, and too often embittered with blows and imprecations. But what of this? affection is stronger than the recollection of injury; he licks the hand that has beaten him,—avenges himself by new proofs of inviolable attachment,—and, with the early morning, recommences his labour of love. Dogs are known thus to guide their masters to houses where they are accustomed to receive alms on certain days, there to lie down at their feet to rest, and not to move till some gratuity has been bestowed. In Rome beggars are thus led to churches in the suburbs, often miles from their residences, where they count their beads, utter a few paternosters, and receive a small piece of money, which is no sooner bestowed than up jumps the dog and proceeds upon his pilgrimage. "I have seen," says Faber, and the same may be often seen, "not without pleasure and surprise, that when a few small pieces of coin were thrown to a blind singer in the street, his dog would pick them all up and place them in the little cap or box held in his master's hand; if bread be thrown, he collected it in the same way, and patiently waiting until his due share was presented to him to satisfy the cravings of hunger." Although it is far from our intention to multiply examples of the reasoning powers of animals, yet we shall detail a few that bear illustratively upon our subject. A friend of ours shooting upon the Everingham estate in York-

Digitized by Google

shire, lost a set of seals by the breaking of the chain by which they were appended to his watch. He recollected to have observed them on his person, when in a large field of turnips, nearly a mile from the spot where he then stood. He called a very intelligent retriever that was with him; he shewed him the broken chain, and compared it with the chain and seals of another gentleman present. Solway understood what had occurred; hurrying off and retracing his steps, he found the lost seals in the turnip field, and brought them to his master. The same gentleman, when he shot a hare early in the day and was unwilling to carry it, always left it in some secure nook, shewing it to the dog, who, on returning in the evening, would, when desired, go and bring it home. A volume of well authenticated anecdotes of this kind might be laid before the inquiring reader; we shall detail one more. Two gentlemen started early from Inverleithen to fish; they were accompanied by a favourite retriever, and walked for some miles up the Tweed before they began to cast their lines. Arrived at their ground, one of the party discovered he had lost his flies; he called his dog, shewed him a similar book belonging to his companion, and desired him to seek its fellow. Off went Can, and, in less than half an hour, returned with the book.

If farther proof is wanted, it is related that at a convent in France twenty paupers were served with dinner at a certain hour every day. A dog belonging to the establishment did not fail to be

Digitized by Google

present at this regale to receive the odds and ends which were now and then thrown down to him. The guests, however, were poor and hungry, and of course not very wasteful, so that their pensioner did little more than scent the feast of which he would fain have partaken. The portions were served out by a person at the ringing of a bell, and delivered out by means of what in religious houses is called a *tour*, which is a machine like the section of a cask, that, by turning round upon a pivot, exhibits whatever is placed on the concave side, without discovering the person who moves it. One day this dog, who had only received a few scraps, waited till the paupers had retired, took the rope in his mouth, and rang the bell. His stratagem succeeded. He repeated it the next day with the same good fortune. At length the cook finding that twenty-one portions were given out instead of twenty, was determined to discover the trick, in doing which he had no great difficulty; for lying *perdu*, and noticing the paupers as they came in with great regularity for their different portions, and seeing there was no intruder except the dog, he began to suspect the real truth, which he was confirmed in when he saw the dog wait with great deliberation till the visitors were all gone and then pull the bell. The matter was related to the community, and to reward him for his ingenuity, he was permitted to ring the bell every day for his dinner, when a mess of broken victuals was purposely served out to him. *(Dibdin's Observations*

Digitized by Google

in a Tour through England.) We are acquainted with an instance somewhat analogous to this: A gentleman visiting a friend, always left his dog, a fine Newfoundland, at the gate. The animal was very anxious to follow his master but never allowed to do so; at length observing that on pulling the bell the gate was invariably opened, he managed to do so for himself, the domestic answered the summons, and in leapt the dog.

The attachment of the dog to his master is inviolable, even in death; to save him he will plunge unhesitatingly into the angry flood, and mourning his loss, he will die of sorrow and of hunger upon his tomb. Virey mentions a dog who was seen by thousands in Paris howling on a piece of ice upon the Seine, from which his master had fallen and sunk amid the waters. Nothing could win him from his post of heroic fidelity and devotion; there he remained for three days and two nights when a thaw commenced and he sunk near the spot where the master he regretted with so much constancy had been seen to disappear. There are many affecting stories of a similar character. Daniel (*Field Sports*, ii. 499) tells of a spaniel who, during the last stage of consumption which carried his master to the grave, unweariedly attended the foot of his bed; when he died the dog would not quit the body, but lay upon the bed by its side. It was with difficulty he was tempted to eat any food; and, although carried to the house of a friend, and caressed with all the tenderness so fond an attach-

Digitized by Google

ment naturally excited, he took every opportunity to steal back to the room where his master had expired and where he would remain for hours. From thence, for fourteen days, he constantly visited the grave, at the end of which time he died—May we not say of a broken heart?

The story of Boswell is not imaginary, for many instances might be adduced where criminals have been discovered and brought to justice through the agency of a dog. It cannot be to simple instinct that these actions are to be referred; on the contrary, the candid and unprejudiced reader must allow that they are the result of very extended and complex processes of reason—a reason differing from that possessed by man not in kind but merely in degree.

The manifestation of reason in dogs has been so considerable, that some writers have been induced, in the spirit of human pride and audacity, to ascribe these actions, not to reason, but to a particular interposition of Divine Providence. Of this nature Mr Kirby, in his interesting but very unequal work, the Bridgewater Treatise, on the history, habits, and instincts of animals, conceives to be the account given by Mr French (*Zool. Journ.* i. 7.) of Sir H. Lee's dog, which saved its master's life by taking and maintaining its station, which it had never done before, under his bed; and also the instance related by Beattie, which we repeat at length:—A gentleman named Irvine was crossing the Dee near Aberdeen, then frozen over, the ice gave way about the

Digitized by Google

middle of the river and he sunk; but having a gun in his hand, he supported himself by placing it across the opening in the ice through which he fell. His dog used many fruitless efforts to save his master, and then ran to a neighbouring village, where he saw a man, and with most significant gestures pulled him by the coat and prevailed upon him to follow him. The man arrived at the spot in time to save the gentleman's life. "These cases are remarkable," says the reverend author, "but they do not appear to belong to instinct, but *rather to the doctrine of a particular Providence.*" It is certainly not to *instinct* that the above quoted *rational* actions can be referred—which, however, we would observe, are not more remarkable than many others which the same animals are known to practise, for the acquirement of an end totally unconnected either with the prevention of a calamity or the production of a benefit, and in which no particular providence could for a moment be supposed to exert its influence. Many we have alluded to bear upon this, as still more so does the following, which Dr Hancock quotes from Dr Abel's Lectures on Phrenology. "The dog, a Newfoundland, was of a generous and noble disposition, and when he left his master's house was often assailed by a number of little noisy dogs in the street. He usually passed them with apparent unconcern, as if they were beneath his notice; but one little cur was particularly troublesome, and at length carried his petulance so far as to bite the Newfoundland dog in the back of his

Digitized by Google

foot. This proved to be a step in wanton abuse and insult beyond what was to be patiently endured, and he instantly turned round, ran after the offender, and seized him by the skin of his back; in this way he carried him to the quay, and holding him for some time over the water, at length dropped him into it. He did not seem, however, to design that the culprit should be punished capitally, and he waited a little while till the poor animal, who was unused to that element, was not only well ducked but near sinking, when he plunged in and brought him safe to land."

Is any "Divine interposition" to be supposed in the following anecdote, which we give as we received it from our reverend friend Dr Duncan, one of the parish ministers of Dumfries:—

One evening in spring, many years ago, the inmates of a farm-house near Gatehouse-of-Fleet were alarmed by a loud screaming and knocking at the kitchen door, accompanied by the flapping of wings. On going to ascertain the cause, the servants discovered a gander in violent agitation, which instantly set off in the direction of the goose-house, at the same time shewing by very significant gestures that he wished to be followed. No sooner had the place been entered than the cause of the commotion became evident. A felon polecat rushed out at the door, and on a nest within, covering a brood of young goslings, sat the body of a slaughtered goose. The affectionate mother had generously maintained her post at the expense of her

Digitized by Google

life, rather than abandon her little ones to her ravenous assailant.

We have shortly alluded to this subject in our eighth chapter; and, at any rate, this is not the place to discuss so unprofitable a doctrine as Mr Kirby advocates. The Christian will readily acknowledge, not only the omnipresence, but the omniscience of God, and confess that not a sparrow falls without his knowledge and permission; but whether at times he does, as He did of old, before the Christian dispensation, forsake the general laws by which he rules and acts in order to adapt them to particular circumstances, we do not believe, but certainly we will not pretend to decide, contenting ourselves with the humble confession, that "such knowledge is too wonderful for us—it is high, we cannot attain unto it."

We may perhaps be permitted shortly to remark, that the supporters of the doctrine in question lay great stress upon the fact, that a man has dreamed he would die upon a certain day, and thus been warned of his approaching fate; that the day has come, and the dream been realized. But is this a particular providence of the Most High? is it His voice speaking amid the airy nothingness of a dream? or is it not rather the effects of an imagination unbridled by the restraints of reason—a partial imbecility, the concomitant of the "fine phrensy" of poesy? Dark things may be done by our own fantastic persuasions, and belief will ensure the miracles that it credits. The most potent

Digitized by Google

witcheries are less potent than fancy itself; and, as we have somewhere seen remarked, Macbeth was a murderer not because the witches predicted, but because their prediction gave origin to the thought.

Among mammals, another very intelligent animal is the horse, of whom we shall mention one anecdote.

Some years ago, when deep-drinking was in vogue, and landlords inhospitable who saw not their guests under the table, a friend of ours possessed a horse very difficult to mount, and, when mounted, highly impatient and irritable. When this gentleman rode home at night from a convivial meeting, his horse seemed conscious of the condition of his master; he permitted himself to be backed with the greatest steadiness; and, although at other times he would evince his disapprobation of the whip by violently kicking, rearing, and running away, now neither whip nor spur would induce him to depart from the walk, or otherwise to shew his displeasure. On these occasions a person has come behind him and applied the whip; for a moment his instinct would preponderate over his reason, and a disposition to resent to injury manifest itself. But it would be for a moment; he scarcely lifted his leg from the ground to inflict the blow when it was quietly replaced, "willing to wound but yet afraid to strike" lest his master should be injured by his petulance.*

* He was the grandson of the Duke of Hamilton's celebrated "Daintie Davie," and like his grandsire brought up by the

Digitized by Google

It is mentioned in the *London Magazine of Natural History* (vol. iv. p. 499.), that a young lamb was observed to be entangled among some briars, and it had seemingly struggled for liberty until it was quite exhausted. Its mother was present, endeavouring with her head and feet to disentangle it. After having attempted in vain for a long time to effect this purpose, she left it, and ran away baaing loudly and dolefully. Thus she proceeded across three fields, until she came to a flock of sheep; among them she tarried for about five minutes, and left accompanied by a large ram that had two powerful horns. They returned speedily towards the poor lamb; and, as soon as they reached it, the ram immediately set about liberating it, which he did in a few minutes, by dragging away the briars with his horns. "Now it may be asked," continues the observer, "what analogy, even in the

hand, his mother dying three days after he was foaled. He lived for the most part, while a colt, in the kitchen of Gribton House, Dumfriesshire, a protege of the cook, sleeping in the "peat neuk" at night, and gamboling among the dogs during the day. These he always accompanied to the chase, and, like them, often made his way, rather an unwelcome guest, to different parts of the house. Till he was taken up for breaking, he evinced the greatest docility, but, no sooner was a bit placed in his mouth and he found himself restrained, than he rushed at the breaker, and pursued him into the kitchen and through other rooms, the man sought protection behind a door against which the horse violently kicked. He was broken, however, but became wild and vicious except on such occasions as we have recorded. He afterwards went to Walcheren, where he was celebrated for the attachment he shewed to his master.

Digitized by Google

remotest degree, had the actions mentioned in the above anecdote to the operations of instinct? Was it an '*involuntary* desire' that induced the sheep to endeavour to liberate her young one when she observed it imprisoned amongst the briars? Was she urged by an 'involuntary desire,' or did she act 'without motive or deliberation' when she ran across three large fields, and surmounted four strong thorn hedges in search of its relief, which, by these means, she must have known, or at least hoped, that she could obtain? Did the ram act 'without motive or deliberation' when he returned with her, of course according to her request, and effected what she desired? Or is it not infinitely more probable, is it not, indeed, indisputable, that these and a thousand actions of a similar nature, which are daily observable in our domesticated animals are 'perfectly free,' are the 'result of volition, are, in short, neither more nor less than the operations of reason?

The following instances, as quoted by Hancock, of the power of goats to accommodate their actions to new circumstances, imply the exercise of the reasoning faculty in no inconsiderable degree. "Two goats grazing about the ramparts of Plymouth citadel, got down upon a narrow ledge of the rock, and one of them, advancing before the other, came to an angle where it was enabled to turn; but, in its way back, met its companion, which produced a most perplexing dilemma, as it was impossible for them to get past each other.

Many persons saw them without being able to lend any assistance. After a considerable time one of the goats was observed to kneel down with great caution, and crouch as close as it could lie; which was no sooner done than the other, with great dexterity, walked over him, and both returned the way they came in perfect safety. And at Ardinglass, near Glenarm in Ireland, two goats, moving towards each other over a precipice a thousand feet high, were seen to extricate themselves from danger by a similar expedient."

In Rees's Cyclopædia the following singular anecdote of a cat is found:—" A lady had a tame bird which she used to let out of its cage every day. One morning, as it was picking up crumbs from the carpet, her cat, who always before shewed great kindness to the bird, seized it on a sudden, and jumped with it in her mouth upon the table. The lady, alarmed for the fate of her favourite, on turning about, observed that a strange cat had just come into the room. After turning it out, her own cat came down from her place of safety, and dropped the bird without inflicting the least injury." On this case Hancock, who also quotes it, remarks, " It seems very clear on considering this act, that various circumstances must have influenced this sagacious animal. She must have known that the bird was in danger from the intruder, and must have reflected on the best means of rescue; and we may take it for granted that instinct could not, on the same principle, have prompted the one

Digitized by Google

cat to destroy and the other cat to save at the same moment of time. But the manner in which the preservation was effected is instructive, and affords a very striking example of reasoning in the brute, the more so as cats are not remarkable for sagacity." (P. 84.)

With regard to birds: in Lord Bacon's writings is to be found an instance of reasoning in a raven, in the application of means to the fulfilment of a desired end which would do no discredit to human sagacity; finding, during a severe drought, water in the bottom of a tin which she could not reach, she threw in stones till the water rose and she could obtain it. This is so remarkable an exercise of reason and display of knowledge acquired by experience, that but for the place where it is found, one would readily infer that Æsop had invented it as a useful lesson of wisdom to man, rather than that a philosopher had actually observed it in a raven.

The Encyclopædia Britannica affords the following fact as is alleged on unimpeachable authority: "In the spring of 1791 a pair of crows made their nest on a tree of which there were several planted around the narrator's garden, and in his morning walks he had often been amused by witnessing ferocious combats between them and a cat. One morning the battle raged more fiercely than usual, till at last the cat gave way and took shelter under a hedge, as if to wait a more favourable opportunity of retreating to the house. The crows continued

Digitized by Google

for a short time to make a threatening noise, but perceiving that on the ground they could do nothing more than threaten, one of them lifted a stone from the middle of the garden and perched with it on a tree planted in the hedge, where she sat watching the motions of the enemy of her young. As the cat crept along under the hedge, the crow accompanied her by flying from branch to branch and from tree to tree; and when at last puss ventured to quit her hiding-place, the crow leaving the trees and hovering over her in the air, let the stone drop from on high on her back. The writer remarks, that the crow on this occasion reasoned is self-evident; and it seems to be little less evident that the ideas employed in her reasoning were enlarged beyond those ideas she had received from her senses. By her senses she may have perceived that the shell of a fish is broken by a fall, but could her senses inform her that a cat would be wounded or driven off the field by the fall of a stone? No; from the effect of the one fall preserved in her memory, she must have inferred the other by her power of reasoning."

Mr White has recorded in Loudon's Magazine (ix. 377), the following proof of reasoning in the domestic cock. One of these birds, belonging to his neighbour, from whose premises his own are separated by a range of stables, &c., regularly pays him a visit at the breakfast and dinner hours. He keeps no poultry. The bird flies to the top of the stables, and watches till the meal is ended,

Digitized by Google

when he descends into the yard to partake of the crumbs, with which the children take great delight in feeding him. "Within the last few days," continues the observer, "his conduct appears to be the result of forethought. On an ample meal being placed before him, he has manifested great anxiety for some of his fair companions to partake of it with him; this he has strongly shewn by taking up pieces in his mouth, calling with loud anxiety, breaking the pieces into smaller portions and laying them down again; then pacing to and fro as if in expectation of the arrival of some of his companions, renewing the dividing of the larger pieces into smaller, and calling with increased anxiety. On two occasions he has left his meal untouched, so far as regards eating any portion of it himself, returned to his own premises, and brought a hen with him to share in his good fortune."

Of birds a thousand anecdotes might be related to prove that *all* their actions cannot be referred to simple instinct, and that many of them must, on the contrary, be elevated into the higher department of reason. The following is well known in Dumfriesshire, and bears so illustratively upon our subject that we must introduce it to the notice of our readers. In consequence of the unusually dry spring of this year (1836), that pretty piece of water upon the lawn before the mansion-house of James Lennox, Esq. of Dalscaith, became very shallow, and exposed the numerous roots of trees thrown in to give shelter to the trout, and which at

Digitized by Google

other times were hid below water. On one of these, more elevated than the others, a pair of the common wild duck (*Anas boschas*) constructed their inartificial nest; but scarcely had a few eggs been deposited when the weather changed, down came the rain, fresh flowed the springs, the neighbouring burns poured the surcharged waters into the lake, which soon began to rise to its accustomed bed, threatening to touch the bottom of the nest, to overwhelm the labours of its luckless owners, and send their eggs adrift upon the swelling tide. But the ducks were not idle in making preparations against the coming peril. It was an unexpected occurrence, for which mere instinct had no resource; reason, however, came to their assistance, and told them plainly it was time "to put their house in order." And so they did. No sooner did they see the lake begin to swell, than one of them was observed to bring rapid supplies of grass and straw and moss, with which the other built away below the nest, gradually raising it upon a new foundation till several inches of elevation were gained; it thus emerged from the flood, the waters became stationary, and the birds quite safe in their domicile. The fond mother now patiently brooded her full time, and one duckling rewarded her maternal care; when, just as it had escaped from the shell, another torrent of rain fell more suddenly and violently than the first, the waters rose higher and higher, the nest and the remaining eggs were swept into the abyss. In this emergency, the whole at-

Digitized by Google

tention of the parents was given to the living progeny, which they safely conveyed to the shore, where another nest was speedily constructed, and their sagacity and solicitude finally crowned with success.

M. Merveaux lately communicated to the French Academy of Sciences a fact very analogous to the preceding. A pair of nightingales had built in the lower part of a hedge in his garden and had deposited four eggs, when some water in the neighbourhood rose with much impetuosity and threatened to reach the nest. M. Merveaux watched the birds with some anxiety, and the day when the water nearly touched the nest, he perceived that only two eggs remained in it. He thought the nest had been abandoned; but looking at it soon after, he found an egg had been removed, and he resolved to watch. He did so; and was much astonished to behold the last egg disappear with the birds, who, flying cautiously but rapidly, carried it to a new nest, at the highest part of the hedge, in which he saw the four eggs safely deposited; and where they were afterwards hatched. He could not ascertain how the eggs had been transported; the fact, however, is undeniable, and highly demonstrative of the reasoning power of the birds.

There is a South American bird, *Psophia crepitans*, which, acording to Sonnini (*Nouv. Dict. d'Hist. Naturelle*, 1. 190), exhibits reasoning powers of a very high order; so much so as to be intrusted with the care of young poultry and even of

Digitized by Google

flocks of sheep, which they conduct to and from their pastures. These animals have a natural inclination for the society of man, and seem to occupy the same place among birds that the dog does among mammals. When taken and fed in a house, it becomes attached to the inmates, and knows, like the dog, the voice of its master; following him when he goes out, leaving him with reluctance, and appearing delighted to see him again. Sensible of his caresses, he returns them with every mark of affection and gratitude; it seems even jealous of his attentions, for it will peck at the legs of those who come too near to him. It knows and acknowledges also the friends of the family. It sometimes takes a dislike to individuals, and whenever they appear, attacks them, and endeavours to drive them away. Its courage is equal to that of the dog, for it will attack animals bigger and better armed than itself. (*Kirby's Bridgewater Treatise*, ii. 455.)

Descending in the scale of creation from the warm-blooded animals—the mammals and birds—to those among the vertebrata, which circulate cold blood—the reptiles and fishes—we pass from the former, possessing a very great degree of intelligence, to others where stupidity is highly developed. Had animals been classified according to their intellectual powers, and not as they are in relation to their structure, fishes would have preceded reptiles, and insects followed the birds. This, however, is not the case; reptiles are placed before fishes, and insects fill a post very far down in the chain of exist-

Digitized by Google

ences. The brain of reptiles is very small, and far from filling the cavity which contains it; their intellectual faculties are proportionate to it, scarcely extending to the taming of a few species of serpent and lizard, and that in a very slight degree. With the reasoning powers of fishes we have not much acquaintance; indeed, as inhabitants of a medium so widely different from that in which man lives and moves and has his being, and in general rapidly perishing when withdrawn from their native element, they are much less frequently the objects of our observation than those animals which, as sharing with us the vital influence of the atmosphere and inhabitants of the soil on which we ourselves rest, we meet with at every turn, and with the forms and habits of which we become almost unconsciously more or less familiar. Fishes are rarely domesticated with us in our houses, we do not meet with them in our walks, they are not presented to our eyes in menageries; we see them for the most part only in our markets, or on our tables, and know them only or chiefly as administering to our palates. If even we follow them to their native haunts, it is in the same spirit that we pursue the fluttering bird with our gun, or the panting hare with our hounds—in pursuit of a barbarous sport, and with no other end in view than the gratification of vanity in the contemplation of our dexterity in hooking and torturing them. But independently of all this, the organization of the fish would lead us to the belief that its intellectual pow-

Digitized by Google

ers were of a very low degree; indeed, the greater part of their nervous energy would seem to be expended in furtherance of their respiratory and other sympathetic and instinctive actions; of the latter they furnish many and remarkable examples, some of which we have mentioned elsewhere. Doubtless the fish is considerably more an instinctive than a rational animal, the chief end of whose being would seem to be the devouring of food—it lives to eat, not eats to live. But nevertheless we cannot deny to it some glimmerings of thought, slight indeed, but not less than its organization would have led us to expect. As examples of these we would take the stratagems which many species practise in the acquisition of their prey—concealing themselves for instance, in the sand or mud to wait for it. This is the practice of the sturgeon, of the European Silure, the largest probably of European river fishes, of the bearded star-gazer, of the hideous European angler or sea-devil, and of several others; the mouths of most of these are furnished with slender vermiform appendages called *cirrhi*, which are made use of by the animal as baits; these swimming in the water while the rest of the fish is immersed in the soil, are mistaken for worms by less intelligent fry, which thus, like many human fools, in their attempts to prey upon others, become themselves the victims. It is not easy to believe that the beaked chætodon or shooting fish did not serve a long apprenticeship to the task before it could acquire its prey in the manner it does with so much certainty and pre-

Digitized by Google

cision. It frequents the shores and mouths of tropical rivers, and when it sees a fly at a distance alighted on any of the plants in shallow water it approaches very slowly, and with the utmost caution, coming as much as possible perpendicularly under the object. Then putting its body in an oblique direction, with the mouth and eyes near the surface, it remains for a moment immoveable. Having fixed its eyes directly on the insect, it shoots at it a drop of water from its tubular snout, but without shewing its mouth above the surface from whence only the drop is seen to rise. This is done with so much dexterity, that though at the distance of four, five, or six feet, it very seldom fails to bring the fly into the water. M. Hommel, the governor of the hospital at Batavia, convinced himself of the truth of this statement by causing some of these fish to be placed in a large tank of water. They soon became reconciled to the confinement; and he had the pleasure of seeing them daily exercising their skill by shooting at flies and other insects which were placed at all distances within the sphere of their vision. They seldom missed their mark. (*Phil. Trans.* vol. 53. p. 89, and 56. 186.)

Besides this, fishes are in a slight degree educatable, and in proportion as they are so they must be considered rational; at the same time it is to be confessed that the result evinces more a desire to obtain food than any thing intellectual. The eels of the orator Hortensius came at his call, entranced, it has been said, like bipeds, with the music of his

Digitized by Google

voice; gold fish are easily taught to take food from the hand; the carp will obey the ringing of a bell; and, it is curious to witness the uproar that takes place in the fish-pond at Logan, in Galloway, the moment the fisherman makes his appearance with his daily store of limpets and other food for his finny charge. The whole surface seems agitated by some vast internal commotion, as hundreds of fishes rush from all corners to one common point where they know they will receive their accustomed food, and where they greedily contend with each other for the delicious mouthful. They are intimately acquainted with the person of their keeper and will feed from his hand, distinguishing him from the numerous visitors who frequent the spot. One old cod, for the pond is a salt water one and connected with the sea, allows the fisherman to stroke his head and even to lift him from the water. Thus it is seen that these animals have at any rate acquired a consciousness of security which cannot be ascribed to any modification of mere instinct, which rather prompt them to shun the deceitful protection of man, as it doubtless did when they were first placed in the pond. But they have acquired knowledge from experience, and such is the result.

The manifestations of reason among insects are very considerable; we shall allude to a few of them. A certain degree of heat is necessary for the development and rearing of the eggs, larvæ and pupæ of the ant; and any one who will watch these animals on a fine sunshiny day must observe the great la-

Digitized by Google

bour they undergo in removing their charge to such places in the nest where the temperature is affected by the sun's rays. Reaumur tells us the ants frequently saved themselves all this trouble, by establishing their colonies between the exterior wooden shutters and panes of his glass hives, where their progeny was at all times, and without the necessity of changing their situation, in a constant, equable, and sufficient temperature. (*Reaum.* v. 709.) Bonnet observed the same fact, (*Œuvres*, ii. 416); and during the last summer we discovered a nest of ants in a hot bed in our garden, under a piece of slate placed there to protect a cucumber from the soil. This we frequently lifted; and whether the day was hot or cold, sunshiny or the contrary, the eggs were always in the same place. When disturbed the ants ran away with them, as in Bonnet's example, but always replaced them. On considering the above, the reader must agree with Kirby and Spence in their remarks on the observations of Reaumur and Bonnet, that it is impossible to refer these facts to instinct, or to account for them without supposing some stray ant, that had insinuated herself into their tropical crevice, first to have been struck with the *thought* of what a prodigious saving of labour and anxiety would accrue to her compatriots by establishing their society here;—that she had communicated her *ideas* to them;—and that they had resolved upon an emigration to this new-discovered country, whose genial clime presented advantages which no other situa-

Digitized by Google

tion could offer. Neither instinct, nor any conceivable modification of instinct, could have taught the ants to avail themselves of a good fortune, which, but for the invention of glass hives, would never have offered itself to a generation of these insects since the creation; for there is nothing analogous in nature to the constant and equable warmth of such a situation, the heat of any accidental mass of fermenting materials soon ceasing, and no heat being given out from a society of bees when lodged in a hollow tree, their natural residence. The conclusion, then, continue these writers, seems irresistible, that reason must have been their guide. (*Entomology*, ii. 519.) Haller gives many examples of bees, having failed by one method in accomplishing a purpose, adopting another, a great manifestation of reason.

Perhaps some apology is due to the reader for troubling him with so many anecdotes, especially since the possession of reason by animals is pretty well established, and the object of this work more to endeavour to shew the conditions on which they become endowed with it; at any rate, the reader will allow that the cases we have quoted require no further comment, proving as they do the possession by the lower animals, not only of deliberate reasoning powers, enabling them at once to co-operate together in the same cause, and to change their measures according to circumstances, and Hope, Fear, Affection, Dislike, and other similar emotions, but also of a sense of justice, and a hatred of oppression,

Digitized by Google

which are justly considered among the higher sentiments, and which, together with the passions and intellectual faculties before alluded to, make up the full compliment of thought. Who also will deny to the jackdaw and ape a propensity to acquisition, to the pigeon and panther vanity, or to most birds and quadrupeds a love of music; and who can consistently concede to them these modifications of the faculty of thinking, and still deny that they exercise the faculty of thought? But it is, perhaps, chiefly in their susceptibility of artificial education that the inferior animals manifest this function; and who has not seen artificially educated horses, dogs, lions, pigs, elephants, bears, monkeys, Canary birds, even fleas? Cormorants and pelicans have been taught to exercise their skill in fishing for the benefit of mankind; and the Bengal sparrow to collect trinkets and bring them to its master; and there are few who have not heard the voice of the bullfinch, which has been taught to pipe to the chamber organ; the starling whistling very elaborate tunes; and, the speech of the parrot or magpie, which has been trained to imitate the articulation of man. Now, in as far as any animal is capable of profiting by experience, whether spontaneously or for force submitted to, in other words in as far as it is educatable—if we may use the expression—it appears to us that it is intellectual. Of all animals man is the most improveable. He is not only individually the most capable of advancing from what he can do, to what he cannot, from what he does know to what

Digitized by Google

he does not; but, having the means also of leaving behind him records of his attainments, so that his successors may begin where he leaves off, his race is susceptible likewise of progressive civilization. And it is chiefly, perhaps, in the last particular that he rises so infinitely superior to the lower animals; which, being not only individually less improveable, but totally incapable of leaving behind them any such records, the attainments of each generation necessarily die with it, and the race, therefore, remains *in statu quo*.

Digitized by Google

CHAPTER XII.

THE SEAT OF THOUGHT.

The Faculty of Thinking is pretty certainly seated in the brain. "In order to have a just idea of thought," says Cabanis, "it is proper to consider the brain as an organ specifically adapted to produce it, in the same way as the stomach and intestines are adapted to produce digestion. The impressions derived from the senses, upon arriving at the brain, make it enter into action, precisely as the aliments do with respect to the stomach, upon arriving at that organ." It is this organ which thinks and wills, and which is the seat also of the sentiments and the affections; the number and extent of the mental operations bearing an exact relation, in all animals, to the relative size and complexity of this brain, and the general development of these in early life, their stationary condition in middle age, and their progressive decay as old age advances—their energy during health and their failure in disease—all corresponds with the state of the brain under these several circumstances. Accordingly in the corallines, which manifest no marks of thought, there is no appearance whatever of a brain, and its existence is somewhat problematical also in most molluscous

Digitized by Google

and testaceous animals; whereas in other molluscous animals and in many insects, which frequently betray very striking indications of this function, the existence of what may be conceived to represent a brain, is much less equivocal than in the other tribes of avertebrate animals. How infinitely superior are the habits of the ant, the spider, and the bee, to those of the polype, the earthworm and the oyster—yet they are not more so than the more voluminous and complicated structure of the nervous system of the former is calculated to explain; and as we rise higher in the scale of creation, it becomes still more obvious how intimately an increasing magnitude and multiplicity of this organ are connected with more numerous and decided manifestations of mind. Thus it becomes, generally speaking, larger and larger, and composed of more and more parts as we rise progressively through fishes, reptiles, birds, and the various tribes of mammals up to man; bearing an average proportion to the spinal chord, in the first of about two to one, in the second about two and a half, in the third about three, in quadrupeds about four, and in man of not less than about twenty-three; and the degree of intellectual superiority, in each case, to the one preceding may be said to correspond almost entirely with this advancement in the size and structure of the brain. The immediate dependence, indeed, of intellect upon the brain has been pretty generally admitted ever since the age of mythology, which represented Minerva the goddess of wisdom, as is-

Digitized by Google

suing ready-armed from the head of Jupiter; and the same fact is continually inculcated by our familiar expressions of long-headed, furnished with plenty of brains and so forth, as applied to an intelligent person, and thick-headed, addle-pated, numskull, &c., as applied to a fool. But with respect to the immediate seat of the affections there has been much less unanimity. By most of the ancient writers these were referred either to the viscera of the chest or belly, or to the chest and belly themselves; and accordingly the words breast and heart are used in almost every page of the oldest book in the world, to signify the affections, and a similar meaning is frequently attached to the words belly, bowels, liver, and reins or kidneys. Job talks of man's belly preparing deceit, and, to describe his affliction, says, that his bowels boiled and rested not; Isaiah uses the phrase sounding of the bowels to signify pity; Jeremiah, to represent his suffering, says that his liver is poured out; and David frequently speaks of his loins as synonymous with his desires. In the earlier profane writers also, the same impression is manifest in their continual use of the words breast, heart, midriff, bowels, and so forth, to signify the affections, and the term big-gutted was not unfrequently applied by them to persons of strong passions, as if there were a direct connection between the strength of the passions and the size of the viscera. By Hippocrates and Plato also, while reason was placed in the brain, passion was explicitly stated to reside in the heart and midriff;

Digitized by Google

and Galen, while he also placed the animal spirits, including reason, in the brain, referred the vital and natural spirits, including, the one the irascible, and the other the concupiscent passions, respectively to the heart and the liver; and it is as influenced by these old notions that we still so universally use the words hearty, heartless, a stomach for any thing, a yearning of the bowels, hot-livered, white-livered, choleric, &c., as emblematic of the passions, and that players constantly place their hands upon their chest when they wish to indicate deep emotion. Nor are these notions supported only by ancient prejudices; not a few modern authors of repute, including Borden, Buffon, Bichât, Cabanis, Reil, and Broussais, having expressly adopted them. "The passions," says Broussais, "are the triumph of the viscera over intelligence." But, if the affections and passions consist merely in perturbations to a greater or less degree of the thoughts, it is obvious that they can no more have a seat distinct from that of thought, than a palpitation of the heart can have a seat distinct from that of the healthy action of that organ; and they are, consequently, like the intellect, energetic in all animals in proportion to the size, not of the viscera of the chest and belly, but of the brain. Thus it is only in the superior tribes of animals—those in which the brain is well developed—that we meet with evident indications of hope, fear, love, hatred, courage, ambition, jealousy, joy, and grief. "Passion," says Bonnet, "has always an object; one does not desire what one does not

Digitized by Google

know. Passion, then, has its beginning in volition: it is Will applied strongly to its object." It is the brain, then, which is always affected the first, and from which the manifestations of the passions extend by sympathy to the other viscera. If, on the contrary, the passions had their primary seat in the viscera of the chest and belly, they should be numerous and violent—as was formerly, but very erroneously, supposed to be the case,—in proportion to the magnitude and complexity of these viscera; but some of these, for example the liver, are relatively the most voluminous in those animals which betray few or no indications of passion. The herbivorous animals also, among the higher orders, have in general larger and more complicated viscera than the carnivorous; but has the peaceful cow, with its four stomachs, long intestines, and voluminous liver, more energetic passions than the savage tiger, in which all these organs are comparatively small and simple? Among mankind also, those individuals who live, as it were, under the dominion of the belly, have, in general, enormous viscera, but they are comparatively destitute—not, indeed, of appetites—but of affections and passions; while, on the other hand, those who exercise rather the functions of the brain are commonly distinguished by the acuteness and intensity of their feelings, and generally display, instead "of the fair round belly," rather the appearance of the "lean and slippered pantaloon." The viscera, then, of the chest and belly, however rapidly and powerfully they may dis-

Digitized by Google

play the effects of the affections and passions, cannot be the immediate seat of them; nor can such emotions have any other seat than that of thought, of which they are only a modification. But neither reason nor passion is essential to life,—therefore many of the lower animals have naturally no brain, and it may be sometimes artificially abstracted from animals, naturally possessed of it, without fatal effects. Thus we learn from the experiments of Redi that the land-tortoise can live six months after having been deprived of its brain; and from those of Spallanzani, that the newt and frog can do almost as well without a brain as with one. In the human being also, as thought is the last function of the nervous system which comes into exercise, so the brain is the last part of this system which is perfected; and as thought is less requisite to the well-being of the embryo and fetus than either irritation or sensation, so, while no mature fetus has ever been born without a ganglionic system of nerves, and extremely few without a spinal chord, innumerable instances are on record of such fetuses having been born without a brain. It is the most sublime, but, at the same time, the least essential part of the nervous system; and, like the third story of an edifice, while it relies for support on the one immediately below it, as this again relies upon the foundation of them all, may itself be deficient, without prejudice to those on which, when present, it is either directly or indirectly dependent.

Digitized by Google

In conclusion, we trust we may be allowed to express a hope, that we have rendered probable the positions with which we started, that the sources of the organic, the instinctive, and the rational motions, are all distinct from each other, an essential condition of the first being irritability, of the second sensibility, and of the third the faculty of thinking; that each of these faculties, as it is different in its nature, so it has also a distinct seat from the rest; and that, while to those animals which possess only a ganglionic system of nerves we allow only organic motions, and to those which display, besides this, a spinal chord, only organic and instinctive motions, we must concede to such as have at once a ganglionic system, a spinal chord and a brain,—which is the case with by far the greater number of animals—not only organic and instinctive motions, but rational motions also. Nor needs man to feel humiliated by an admission which still leaves all created beings at so immeasurable a distance from him even in this state of existence, if not in the kind, at least in the degree, of their faculties; and which further reserves to him, by the especial favour of his Creator, a distinction infinitely more excellent in the prospect of immortality.

Digitized by Google

ILLUSTRATIONS.

PLATE I.

FIG. 1. (*Paxton.*) Left side of the brain and spinal chord, shewn by making a section of the cranium and spinal marrow.

a, The cerebrum;
b, The cerebellum;
c, The medulla oblongata;
d, The spinal chord, extending from the first cervical vertebra, and terminating at
e, The cauda equina.

FIG. 2. Posterior view of the nervous centre, with the origin of the spinal nerves.

PLATE II.

FIG. 1. (*Paxton*) Base of the brain, with medulla oblongata.

a, Anterior lobes;
b, Middle lobes;
c, Corpora albicantia;
d, Pons Varolii;
e, Superior vermiform process;
f, Cerebellum;
g, Inferior vermiform process;
* *h*, Medulla oblongata—the letter being placed on the corpora pyramidalia;
i, Corpora olivaria;
k, Posterior lobes;
n, Pituitary stem.

* In the text this letter is inadvertently said to be placed on the corpora olivaria.

Digitized by Google

FIG. 2. (*Paxton.*) Horizontal section of the cerebrum.

a, *a*, Anterior cornua of the lateral ventricles;
b, *b*, Posterior cornua;
c, *c*, Corpora striata;
f, *d*, Septum lucidum, extending between the two letters;
g, *g*, Choroid plexus—a tissue of bloodvessels.

PLATE III.

FIG. 1. (*Paxton.*) Horizontal section of the cerebrum, with oblique division of the cerebellum.

a, Anterior part of the corpus callosum;
b, Corpus striatum;
c, Optic thalamus;
d, Tænia semicircularis;
e, Anterior pillars of fornix, cut off at their base;
f, Commissure of the optic thalami;
g, Pineal gland, situated on four eminences termed the corpora quadrigemina;
h, Valve of Vieussens;
k, Arbor vitæ, shewn by an oblique section of
n, The cerebellum;
l, Fourth ventricle, terminating in
m, The calamus scriptorius.

FIG. 2. (*Paxton.*) Transverse section of the brain, upon a level with the corpus callosum.

a, *a*, *a*, Corticular part of the convolutions, with the fissures between them;
b, *b*, The medullary part, forming the centrum ovale;
c, The corpus callosum.

PLATE IV.

FIG. 1. (*Milne-Edwards.*) Encephalic nerves.

A, Anterior lobe of the brain;
B, Middle lobe;
C, Posterior lobe;
D, Cerebellum;
E, Medulla oblongata;

Digitized by Google

f, Divided corpus callosum;
1, First pair, or olfactory nerves;
2, Second or optic;
3, Third, or motores oculorum;
4, Fourth, or pathetic;
5, Fifth, or trigeminus; 5 *a*, ophthalmic branch; 5, superior maxillary branch; 5 *b*, inferior maxillary branch;
6, Sixth pair;
7, Seventh pair, divided into two portions, the *auditory*, or portio mollis, and *facial*, or portio dura;
10, The par vagum, a portion of the eighth pair;
12, The accessory nerve of Willis, a second portion of the eighth pair;
9, The glosso-pharyngeal, a third portion of the eighth pair;
11, Ninth pair, or lingual.

FIG. 2. (*Handyside.*) Distribution of the fifth pair of nerves on the left side.

A, Superior maxillary bone;
B, Inferior maxillary bone;
C, Nasal bone;
D, Section of frontal bone;
E, Portion of malar bone;
F, Eyeball, with entrance into it of the optic nerve;
G, Floor of the orbit;
H, Tongue;
I, I, Section of pons Varolii;
K, L, Trunks of the fifth pair, as they pass from their origin through the pons Varolii. K, small anterior or motive root; L, large posterior, or sensitive root.
M, Gasserian ganglion, concealing from view the continuation of K, as that root lies to the inner side of the ganglion, on its way to I, I, I.
First, or ophthalmic division of the fifth pair.

Digitized by Google

1, 1, Recurrent branches, passing between the layers of the tentorium.

2, Lacrymal nerve;

a, Its external branches,

b, Its internal branches.

3, Frontal nerve;

c, Supra-trochlear nerve.

4, Nasal nerve;

o, Large root of

x, Ophthalmic ganglion, connected with the sense of sight by

y, Long and short ciliary nerves;

s, Ethmoidal nerve;

t, Its lateral nasal branch;

v, Infra-trochlear nerve.

Second, or superior maxillary division.

1, 1, 1, Orbital nerve;

a, Subcutaneous malæ;

b, Temporal nerve.

2, Spheno-palatine nerves;

c, Greater palatine, giving branches to the nostrils;

d, Lesser palatine;

z, Spheno-palatine ganglion, on the root of 2, and connected by branches with the sense of smell.

3, Posterior dental (greater and lesser);

4, Anterior dental;

5, Infra-orbital;

e, Inferior palpebral branches;

f, Lateral nasal;

g, Superior labial.

Third, or inferior maxillary division.

1, 1, 1, Lingual or gustatory nerve;

2, 2, Chorda tympani;

Digitized by Google

3, Submaxillary nerve, on which is

* Submaxillary ganglion, with its branches to the submaxillary gland connected with the sense of taste.

4, 4, Inferior dental nerve;

5, 5, Mental nerve;

16, Inferior labial branches.

6, 6, Deep temporal nerves (anterior and posterior);

7, Buccal nerve;

8, Pterygoid nerves (external and internal);

9, Masseteric nerve;

10, Superficial temporal (or auricularis anterior);

11, Mylo-hyoid and digastric branches;

† Otic ganglion. Its situation on the inner side of the sensitive root of I, I, I, is marked by a dotted line. It is connected by its branches with the sense of hearing.

PLATE V.

FIG. 1. Ganglia.

FIG. 2. (*Paxton.*) Some of the principal nervous ganglia and plexuses of the thorax and abdomen, with the pneumogastric nerve.

a, *a*, Thoracic ganglia;

b, The pneumo-gastric nerve;

c, A branch of the former, called the inferior laryngeal or recurrent, curving round the arch of the aorta;

d, Æsophageal plexus;

e, Pericardium;

f, Lungs;

r, Pulmonary plexus;

g, Diaphragm;

h, Spleen;

i, Stomach;

The two last named organs are turned aside to shew the distribution of the nerves.

k, Kidney;

l, Abdominal aorta;

Digitized by Google

m, Semilunar ganglion, and solar plexus, the latter radiating to all the divisions of the aorta;
n, Splenic plexus;
o, Pancreas;
p, *p*, *p*, Lumbar ganglia;
q, Obturator nerve.

PLATE VI.

Fig. 1. (*Grant.*) Nervous system in the Beroe pileus.
... 2. ... .Star-fish.
... 3. ... .Ascaris, or intestinal worm.
... 4. ... .Earth-worm.
... 5. (*Herold.*) ....larva of Cabbage Butterfly.
... 6. ... .pupa ... ...
... 7. ... .imago ... ...

PLATE VII.

Fig. 1. (*Treviranus and Muller.*) Motor tract in Scorpion.
... 2. (*Andouin.*) Nervous system in Sandhopper.
... 3. (*Edwards.*) ....Cymothea.
... 4. (*Succow.*) ....Lobster.
... 5. (*Grant.*) ....Maia.

PLATE VIII.

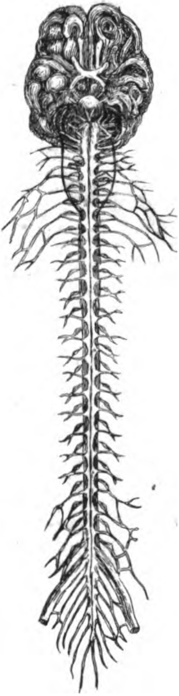
Fig. 1. (*Grant.*) Nervous system in common Mussel.
... 2. (*Chiaji.*) ....Argonauta.

Digitized by Google

Plate I.

Fig 1

Fig. 2



Forrester & Nichol lithog: Edin^{r}

Digitized by Google

Digitized by Google

Plate II.

Fig. 1.

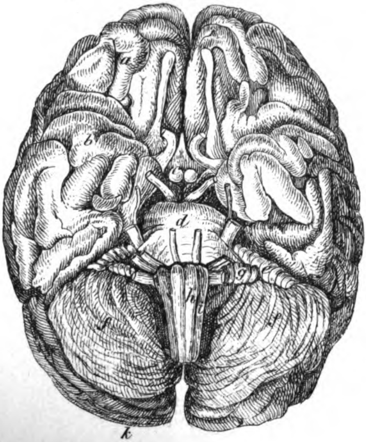


Fig. 2.

Forrester & Nichol lithog: Edin.

Digitized by Google

Digitized by Google

Fig. 1.

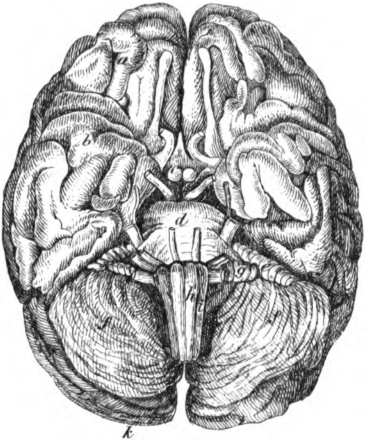
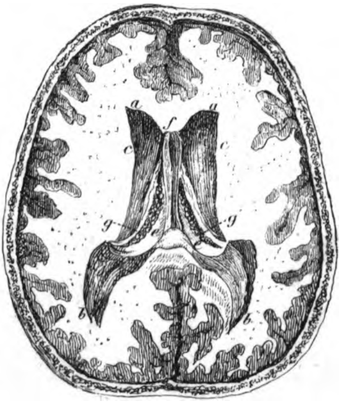


Fig. 2.



Forrester & Nichol Lithog. Edinr.

Digitized by Google

Digitized by Google

Fig.1.

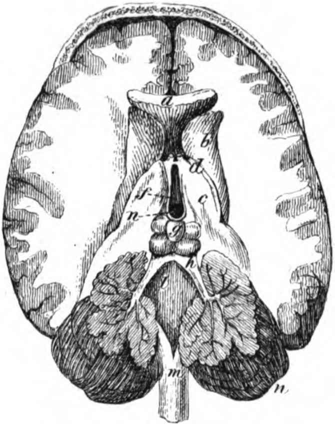
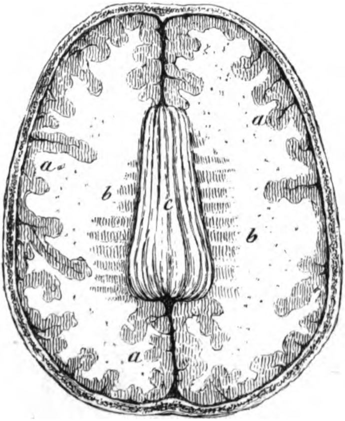


Fig.2.



Forrester & Nichol, lithog: Edinr.

Digitized by Google

Fig. 1.

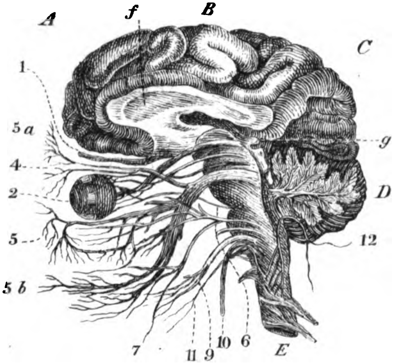
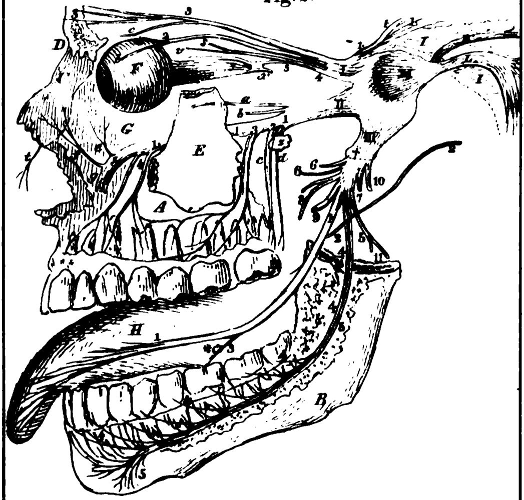


Fig. 2.



Forrester & Nichol lithog. Edin.

Digitized by Google

Digitized by Google

Plate V.

Fig. 1.

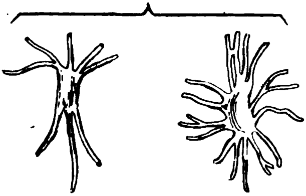
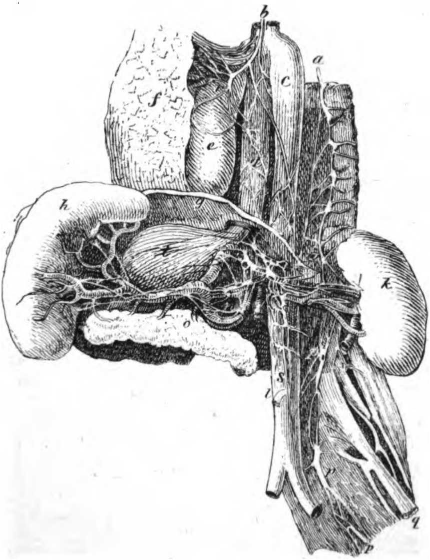


Fig. 2

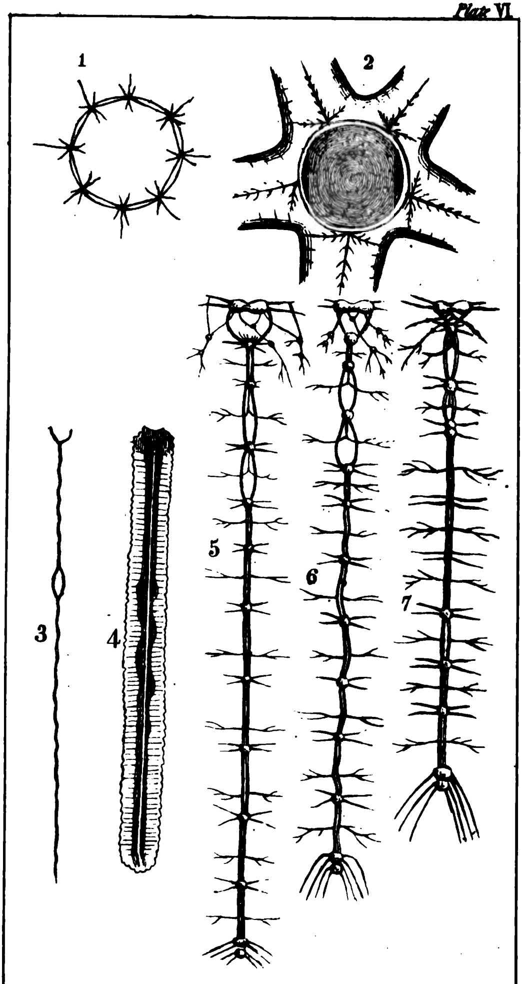


Forrester & Nichol lithog. Edin.r

Digitized by Google

Digitized by Google

Plate VI.

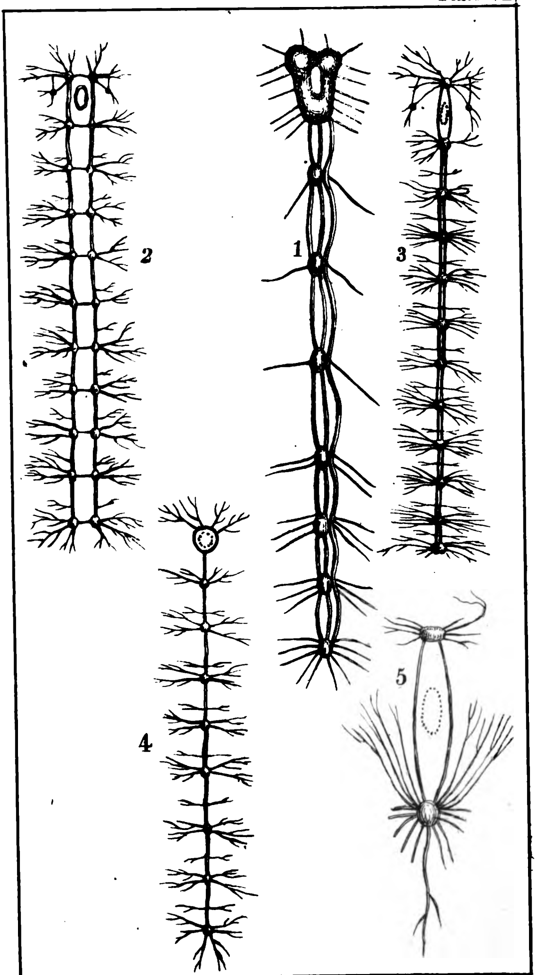


Forrester & Nichol lithog. Edin.r

Digitized by Google

Digitized by Google

Plate VII.



Forrester & Nichol Lithog Edinr.

Digitized by Google

Digitized by Google

Plate VIII.

Fig. 1.

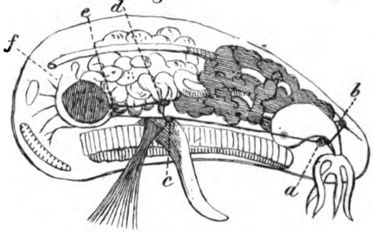
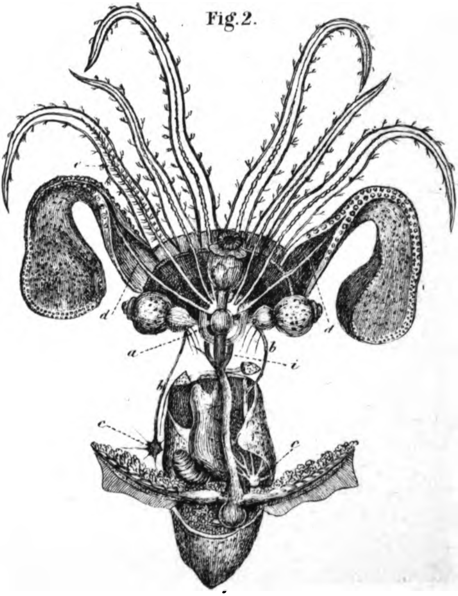


Fig. 2.



Forrester & Nichol Lithog: Edin:

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google